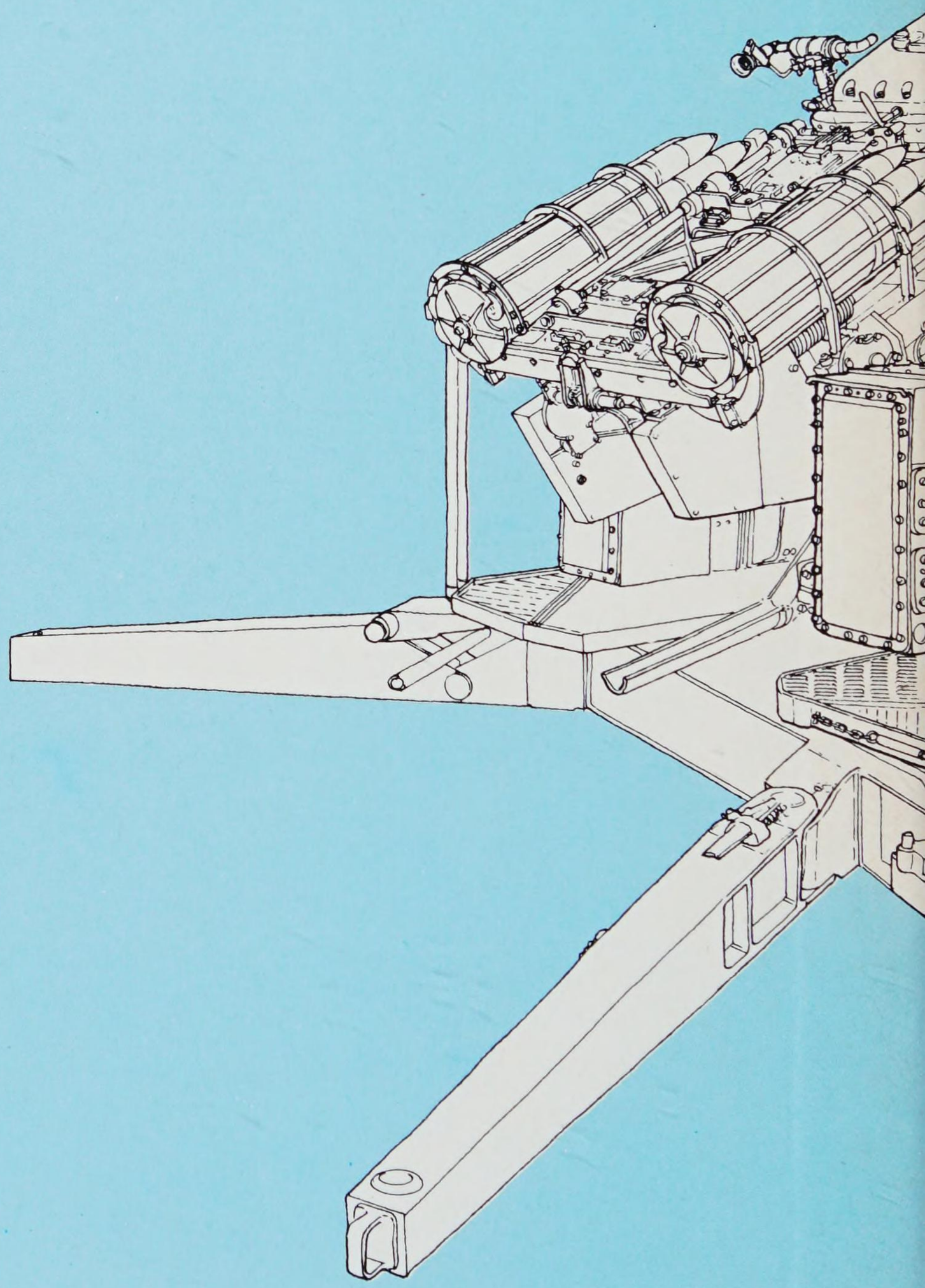
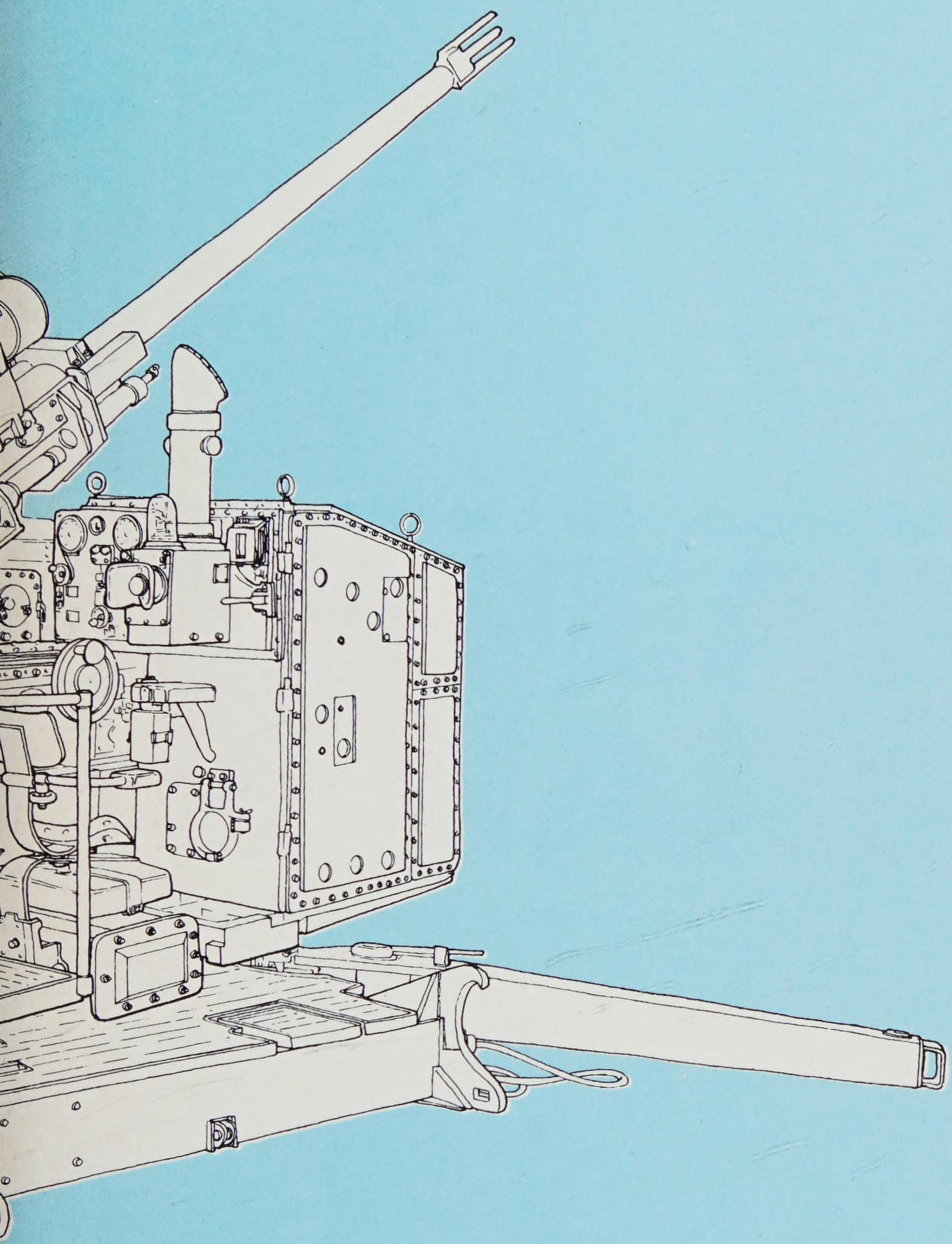
The Illustrated Encyclopedia of 20th Century

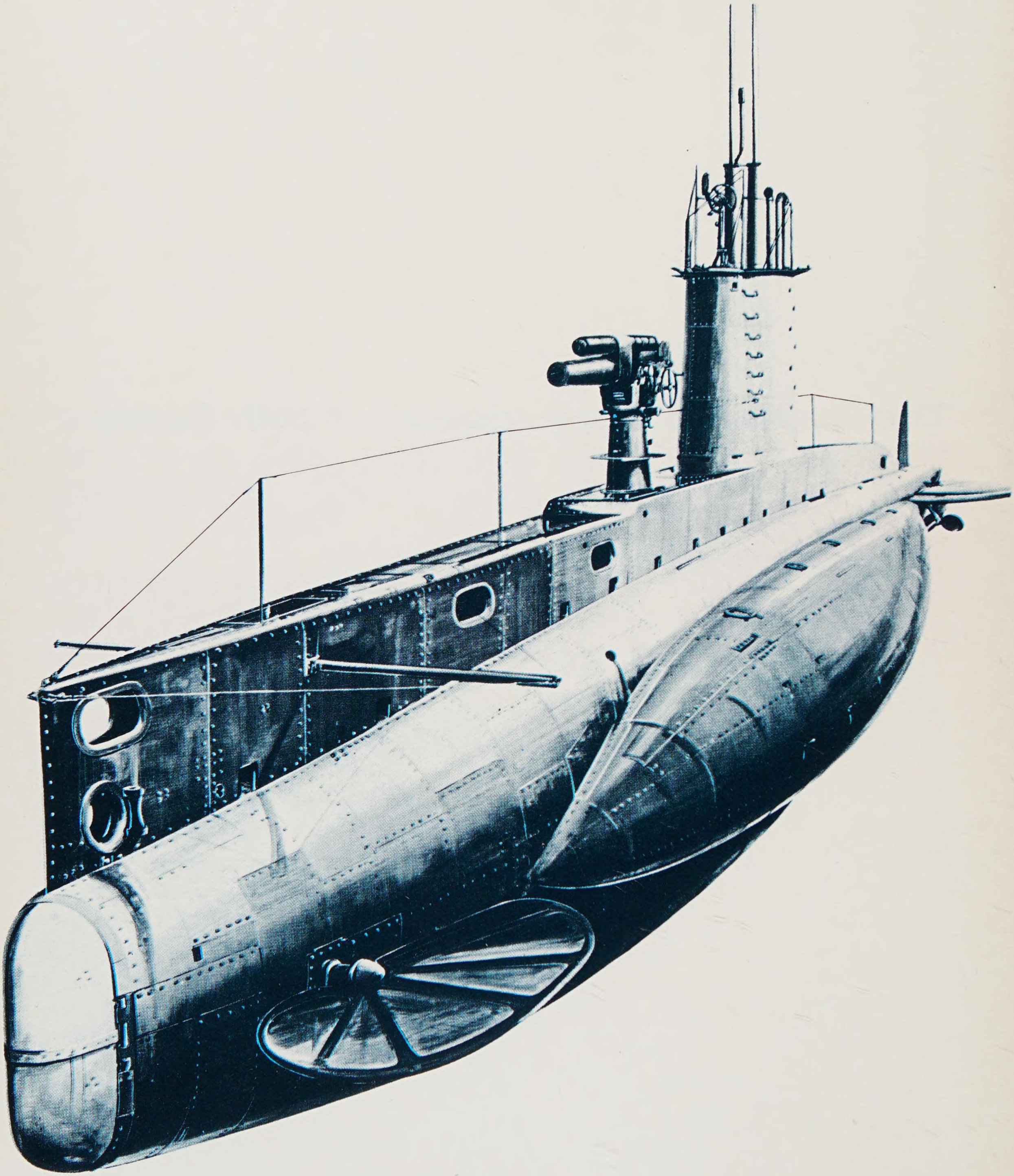
WEAPONS AND WARFARE





The Illustrated Encyclopedia of 20th Century

WEAPONS AND WARFARE



VOLUME 7

D1/Doxa

The Illustrated Encyclopedia of 20th Century

WEAPONS AND WARFARE

COLUMBIA HOUSE/New York

Editor: Bernard Fitzsimons
Consultant Editors: Bill Gunston (Aviation)
Ian V. Hogg (Land Weapons)
Antony Preston (Naval)
Deputy Editor: Suzanne Walker
Copy Editor: Michael Maddison
Assistant Editors: Will Fowler, Richard Green,
Corinne Benicka, John
Liebmann, Michael de Luca
Editorial Assistant: Julie Leitch
Art Editor: David Harper
Assistant Art Editor: John Bickerton
Design Assistants: Jeff Gurney, John Voce
Production: Sheila Biddlecombe
Picture Research: Jonathan Moore
Contributors: Chaz Bowyer/Charles Gilson/
Bill Gunston/Mark Hewish/
Ian V. Hogg/David Lyon/
Hugh Lyon/Pamela Matthews/
Kenneth Munson/Antony Preston/
John A. Roberts/John S. Weeks
Illustrator: John Batchelor
Cover Design: Harry W. Fass
Production Manager: Stephen Charkow

© Purnell & Sons Ltd. 1967/1969
© Phoebus Publishing Company/BPC Publishing Ltd. 1971/77/78
Distributed by Columbia House, a Division of CBS Inc.,
1211 Avenue of the Americas, New York, New York 10036
Printed in the U.S.A.

"It is fatal to enter any war without the will to win it."—Douglas MacArthur

INTRODUCTION

Among the entries in Volume 7 of *The Illustrated Encyclopedia of 20th Century Weapons and Warfare* are a number of the designs of two of the most famous names in aviation history, the Englishman Geoffrey de Havilland and the German Claudius Dornier.

The former began his aeronautical career in 1908 by designing his own aero engine, building an airplane around it, and then teaching himself to fly. At the end of 1909 he joined the staff of the Royal Balloon Factory (later the Army Aircraft Factory, now the Royal Aircraft Establishment) at Farnborough, where he made an immediate and lasting impact. De Havilland's second airplane became the progenitor of the famous F.E.2 and 2b fighting scouts; his "rebuilding" of a damaged Voisin biplane was the first step in the production of the famous B.E.2 series, over 3000 of which were produced; and his last project at Farnborough was the 1914 B.S.1, the first aircraft in the world designed as a high-speed scout, from which sprang the S.E. fighter series, including over 5000 of the S.E.5 and 5A.

In 1914 de Havilland left Farnborough to become chief designer with the Aircraft Manufacturing Company, for whom he designed the **D.H.1—D.H.9** series of combat aircraft, as well as the D.H.10 Amiens and the D.H.14 Okapi. After the war he formed the de Havilland Aircraft Company, whose products included such remarkable aircraft as the all-wood Mosquito, one of the most versatile combat aircraft of the Second World War, the jet-powered Vampire and Venom, two of Britain's most successful postwar aircraft, as well as the Comet, the first jet airliner to fly a passenger service.

Although the years following the First World War proved difficult for aircraft designers all over the world, as defense spending was cut back, they were even harder in Germany. Under the terms of the Armistice, severe restrictions were placed on the building of powered aircraft. For example, any single-seater with an engine of more than 60 hp or any aircraft with provision for armament or having an engine supercharger was considered to have military potential and consequently forbidden, and there were further restrictions on speed, ceiling, load and fuel capacity.

It is all the more remarkable, then, that Dornier should have contrived to continue and expand his activities. Dornier had begun his career in 1910 with the Zeppelin organization, carrying out aerodynamic research for the construction of all-metal airships. In 1915 he had so impressed Graf von Zeppelin that a subsidiary of the firm, the Zeppelin-Werke Lindau, was set up to enable the young designer to carry on his work on all-metal seaplanes. While none of these was built in quantity, they were notable for the advanced constructional techniques—Dornier was, in particular, a pioneer of all-metal aircraft—and after the war the Lindau firm became Dornier Metallbauten (metal construction) . To evade the restrictions of the Armistice, a subsidiary was formed in Italy, and among the products of the new company was the highly successful Wal passenger seaplane which saw worldwide service. In 1926 a new factory was established near Altenrhein in Switzerland, where the military versions of his **Do C, D** and **T** transports were developed. (Another product of the Swiss factory, incidentally, was the Swiss **D-3800** license-built version of the M.S.405 produced for the Swiss air force.)

Dornier continued his work with the **Do 11, 13** and **23** bombers, which all began ostensibly as civil aircraft; the **Do 18** flying boat successor to the Wal; the **Do 22** torpedo bomber/reconnaissance aircraft, which had the remarkable distinction of fighting on both Axis and Allied sides during the Second World War; the **Do 24** and **Do 26** flying boats; and the versatile **Do 217** bomber, night fighter and missile carrier. Dornier had played an extremely important role in the re-establishment of the German aircraft industry, and his company has remained in existence since the war, producing such versatile aircraft as the Ag-Cat and Turbo-Cat agricultural aircraft, the Skyservant STOL transport, and collaborating with the French Dassault-Breguet company to produce the Alpha Jet light strike/trainer. And as a reminder of the past, it proposed in the mid-1970s a turbine-engined version of the Do 24, originally designed for the Dutch East Indies navy in 1935, as an air-sea rescue aircraft for the Spanish air force.

D

D type Austro-Hungarian/German First World War biplane fighters See **Albatros, Fokker, Halberstadt, Hansa-Brandenburg, Junkers, Pfalz, Phönix, Roland, Siemens-Schuckert**

'D' Class British destroyers (1894-1901) See ***Desperate***

'D' Class British destroyers (1930) See ***Defender***

D.1

British submarine class, built 1907-1911. A prototype, *D.1* was ordered under the 1906-07 Estimates from Vickers, followed by seven more under the 1907-08 Estimates. The new boats marked a radical departure from previous British submarines, in being designed for 'overseas' or patrol duties, as against coastal patrol and harbour defence. This in effect meant larger dimensions to allow greater crew-comfort, which had limited the endurance of submarines much more effectively than lack of fuel.

The new submarines were given a Vickers-built diesel engine, the first of this type used in British submarines. The advantage of the diesel was that its power/weight ratio compared favourably with that of the gasoline internal-combustion engine, but without the volatile fuel which was liable to cause explosions in a confined space. Diesel fuel was more inert, and it proved the key to future progress; thereafter no more gasoline-engined submarines were built for the Royal Navy.

The 'D' Class were moderately successful, although their primitive diesel engines were none too reliable. They served in home waters until the outbreak of war in 1914, and served from 1914 to 1918 at Dover, Harwich and Immingham. Thereafter most were relegated to training, but one or two were used on antisubmarine patrols. *D.7* torpedoed *U45* west of Ireland on September 12, 1917 and *D.4* torpedoed *UB 72* in the Western Channel on May 12, 1918. In wartime they were allocated pendant numbers *1.71-1.78.*

The first boat to be lost was *D.5,* sunk by a German mine in the North Sea on November 3, 1914, and she was followed on November 25 by *D.2,* sunk by patrol craft off the Ems Estuary. *D.3* was sunk in error by a French airship in the English Channel on March 15, 1918, and on June 26 *D.6* was torpedoed by *UB 73* off the coast of Northern Ireland. *D.1* was sunk as a target on October 23, 1918 and the last three were sold in December 1921.

Launched during 1907-1911 the Royal Navy's 'D' Class submarines were the first British submarines to be driven by diesel engines. They were bigger than the previous 'C' Class and besides having greater endurance were more habitable and roomier. Four out of the eight built were lost in action during the First World War, but they sank two U-Boats in 1917-1918. *D.3* (above) was sunk in error by a French airship in March 1918

D 1, Dewoitine

D.1 was launched in May 1908; *D.2* in May 1910; *D.3* in October 1910; *D.4* in May 1911; *D.5* in August 1911; *D.6* in October 1911; *D.7* in January 1911; and *D.8* in September 1911. *D.1-D.6* were built by Vickers and *D.7* and *D.8* were built by Chatham dockyard.

Displacement: 464-494/590-620 tons (surfaced/submerged) *Length: D.1,* 49.86 m (163 ft 7 in) oa; *D.2,* 49.4 m (162 ft 1 in) oa; *D.3-8,* 50.16 m (164 ft 7 in) oa *Beam:* 6.22-6.25 m (20 ft 5 in-20 ft 6 in) *Draught:* 3.53 m (11 ft 7 in) *Machinery:* 2-shaft diesel engines/electric motors *Armament:* 12-pdr, 3-in (76-mm) gun carried in *D.4* (in disappearing mounting); by 1918 *D.3-4, D.6-8* were armed with a single 12-pdr deck-gun; 3 18-in (46-cm) torpedo tubes (2 forward, 1 aft, 6 torpedoes) *Crew:* 20

D 1, Dewoitine

French fighter aircraft. Designed by Emile Dewoitine to compete in the French single-seat fighter competition of 1921, the prototype D 1 flew for the first time on November 18 of that year. After prolonged evaluation of all the 1921 contenders, the Dewoitine D 1 and Spad 80 each received a contract in 1924 for 80 aircraft, the two types being intended to replace Spad XIIIs and XXs in Aviation Militaire squadrons. A further 29 D 1s were ordered subsequently for the Aéronavale.

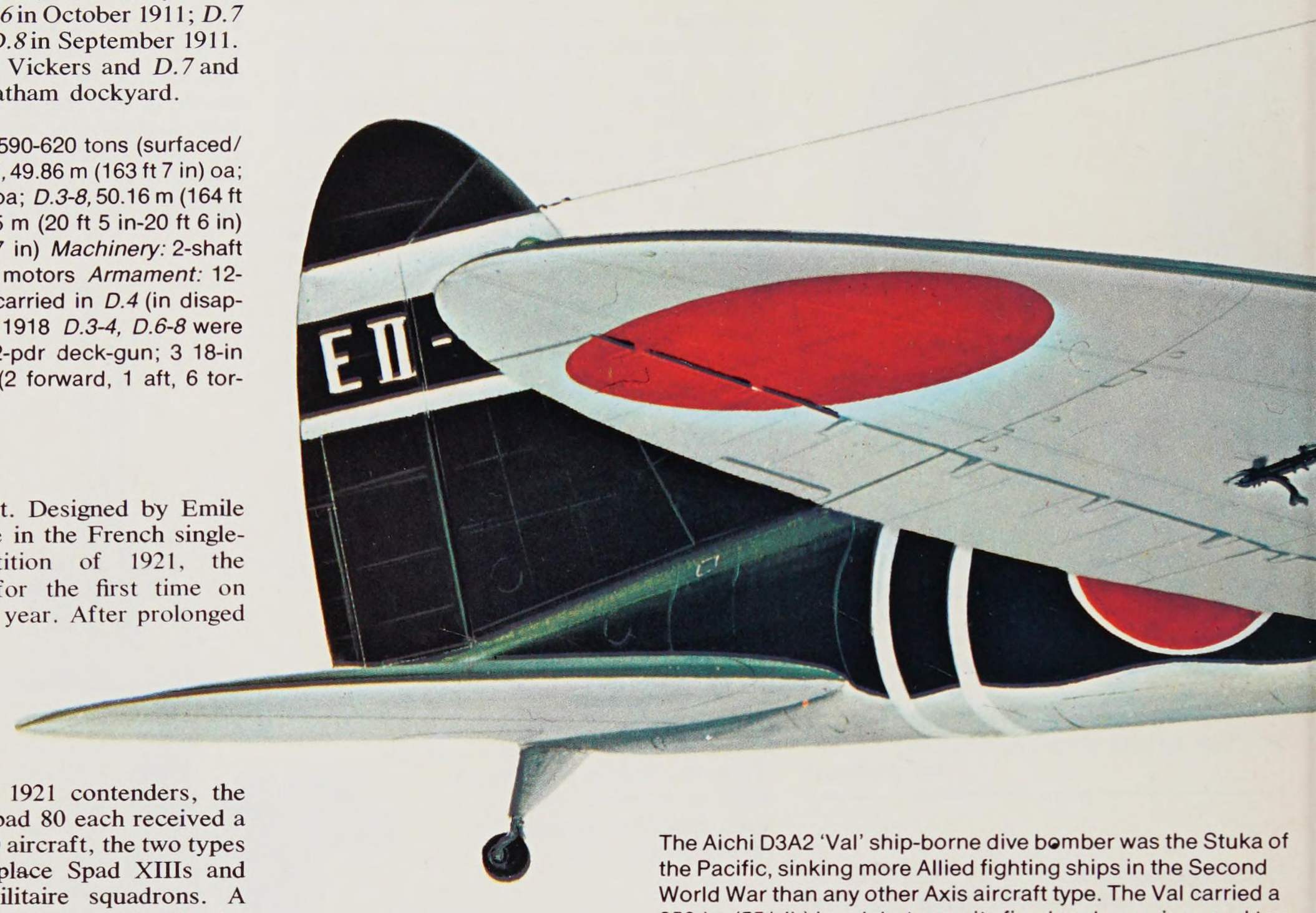
A parasol monoplane, powered by a 300-hp Hispano-Suiza 8 Fb V-8 engine, the D 1 was unusual in that the wing centre-section was supported above the fuselage by a 'solid' pylon fairing instead of the usual series of struts. The prototype performed well—Dewoitine's chief test pilot, Marcel Doret, set up speed records (with and without payload) of 233.10 km/h (144.84 mph) on December 23, 1924, and the D 1 could climb to 5000 m (16404 ft) in 15.1 minutes.

The production aircraft, however, built by SECM (Société d'Enboutissage et de Constructions Mécaniques) required several successive structural reinforcements, and did not gain acceptance by the Aviation Militaire until 1929. The D 1 was of mixed construction, with an open cockpit and two 7.5-mm (0.295-in) machine-guns in the engine upper decking. The final version, the D 1*ter*, had a more conventional strut-type centresection cabane.

Most Aviation Militaire D 1s were soon transferred to the Aéronavale units, including 3C2, 4C1, 7C1 and 7C3; by mid-1931 these units had re-equipped with the Nieuport-Delage 62. Dewoitine D 1s were exported to Japan (one), Switzerland (two) and Yugoslavia (79), and a further 126 were built by Ansaldo at Turin for the Regia Aeronautica, with the designation AC 2.

Span: 11.50 m (37 ft 8¾ in) *Length:* 7.50 m (24 ft 7¼ in) *Gross weight:* 1240 kg (2734 lb) *Maximum speed:* 247 km/h (153 mph)

D 1-D 3 US submarines See ***Narwhal***



The Aichi D3A2 'Val' ship-borne dive bomber was the Stuka of the Pacific, sinking more Allied fighting ships in the Second World War than any other Axis aircraft type. The Val carried a 250-kg (551-lb) bomb between its fixed undercarriage and two 60-kg (132-lb) under the outer wings. Vals saw action at Pearl Harbor and on carrier raids into the Indian Ocean where they sank HMS *Dorsetshire, Cornwall* and the carrier *Hermes*

D1A, Aichi

Japanese carrier-based dive bomber. Based on the Heinkel He 50, this robust two-bay biplane was powered by a 580-hp Nakajima Kotobuki 2 Kai 1 9-cylinder radial (derived from the Bristol Jupiter). Armament comprised two synchronized 7.7-mm (0.303-in) Type 92 machine-guns and a third aimed by the observer in the rear cockpit. A 250-kg (551-lb) bomb could be swung down on a hinged yoke under the fuselage and two 30-kg (66-lb) bombs could be attached under the non-folding wings. The D1A1 was ordered over two rival designs in late 1934.

By 1937 a total of 162 had been delivered, the last 44 having the 715-hp Kotobuki 3 engine. While this first model saw much action in China, Aichi's design team under Goake created an improved D1A2 with 730-hp Nakajima Hikaru 1 engine in a full-length cowl, spats and improved windshields. The first A2 flew late in 1936 and by 1940 Aichi had delivered no fewer than 428 as Type 96 carrier bombers. Most saw action in China, one unit dive-bombing and sinking the US gunboat *Panay* in the Yangtze in 1937. By December 1941 only 68 were still on charge; these were code-named 'Susie'.

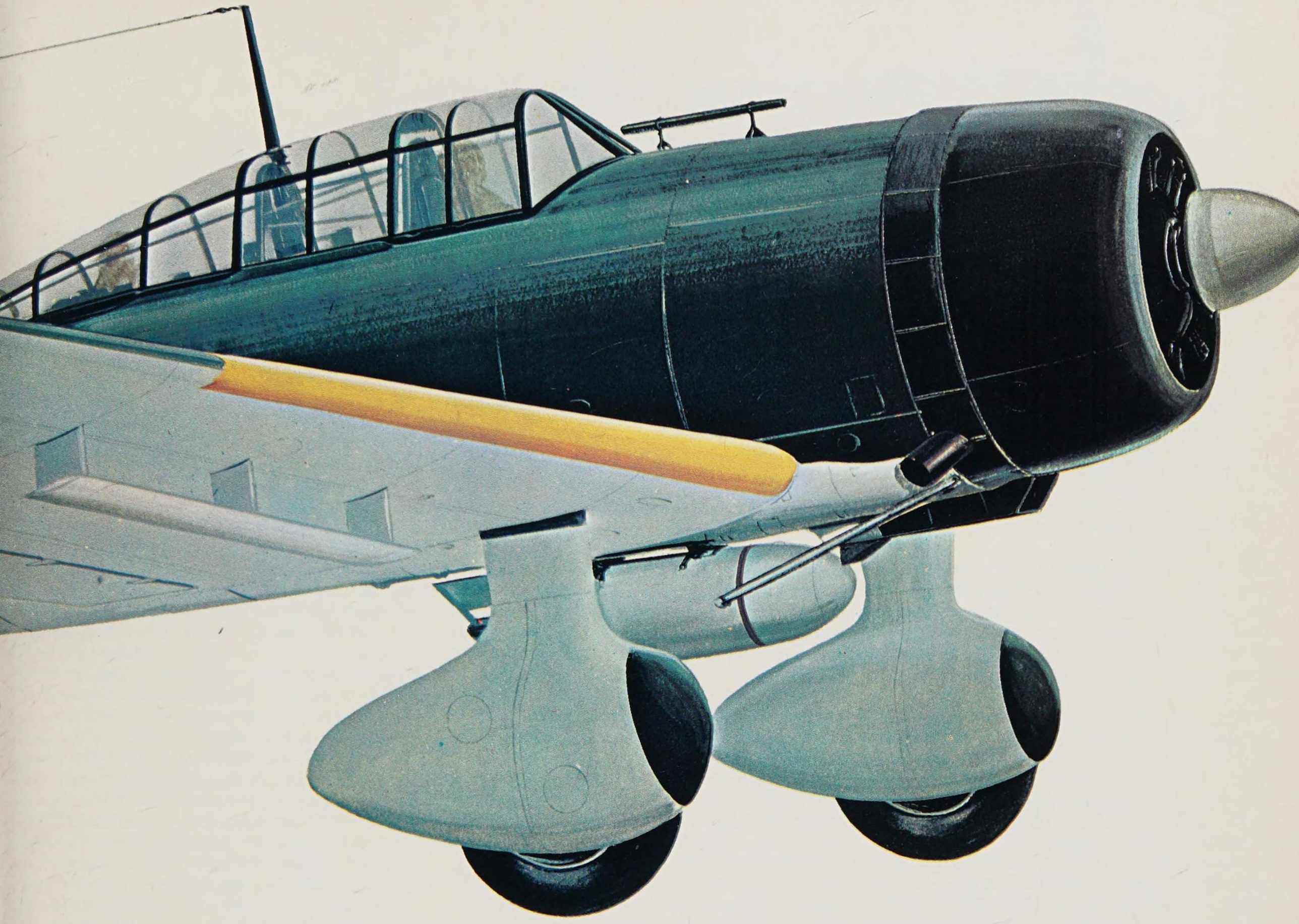
Span: 11.4 m (37 ft 4¾ in) *Length:* 9.3 m (30 ft 6 in) *Gross weight:* 2610 kg (5754 lb) *Maximum speed:* (D1A2) 309 km/h (192 mph)

D2-3

Spanish submarine class. The Spanish navy ordered three 'D' Class submarines under the terms of the Spanish 1926 Shipbuilding Programme. They were designed in collaboration with the British firm of Vickers-Armstrong, and were based on contemporary British submarine practice. All three were built by the Sociedad Española de Constructión Naval at Cartagena. Only two had been started before 1936, and their construction was suspended until well after the end of the Spanish Civil War. By 1944 the design was already obsolete, but it was the only one available, so the first two were completed and the third one built.

As built, they had four bow and two stern 21-in (53-cm) torpedo tubes. A 4.7-in (120-mm) gun was mounted on a forward extension of the lower conning tower, and a quadruple 37-mm AA mount was fitted on a bandstand on the aft end of the conning

No	laid down	launched	completed
D1	12/1933	5/1944	1947
D2	9/1934	12/1944	4/1951
D3	9/1945	2/1952	2/1954



tower. They had a crew of 60, a range of 14 500 km (9010 miles), and a maximum diving depth of about 80 m (262 ft).

D1 was never rebuilt, and was discarded in her original state in December 1965. She had been allocated the pennant number *S-11* in 1961. However, *D2* and *D3* (which had been allocated the numbers *S-21* and *S-22* respectively in 1961) were extensively modernized in 1963. The gun armament was removed and the conning tower streamlined, and they were fitted with modern American radar and sonar. At the same time the interior of the boats was completely refitted and air conditioning was installed. They retained their original machinery, so that although the noise they made submerged was reduced, their performance was not improved. Both were discarded in the early 1970s.

Displacement: 1200/1480 tons (surface/submerged) *Length:* 84.3 m (276 ft 6 in) oa *Beam:* 6.7 m (22 ft) *Draught:* 4 m (13 ft) *Machinery:* 2-shaft diesel/electric motors, 5000 bhp/1300 shp=20.5/9.5 knots (surface/submerged) *Armament:* 6 21-in (53-cm) torpedo tubes *Crew:* 75

D3A, Aichi

Japanese carrier-based bomber and trainer. Similar to the renowned 'Stuka' (Ju 87) in configuration, the D3A flew four years before Pearl Harbor yet apparently remained unknown to Allied intelligence. It hit Pearl Harbor with devastating effectiveness, and is alleged to have sunk more Allied warships than any other aircraft in the Second World War, Stuka included.

It was designed by a team under Tokuhishiro Goake to meet a 1936 Japanese navy requirement for a monoplane to replace the D1A. After curing various faults Aichi won over Nakajima and built six service-trials aircraft and 470 production D3A1s between 1939 and 1942. Features included strong elliptical wings, with narrow dive brakes and carrying spatted landing gears, a 1000-hp Mitsubishi Kinsei radial, tandem cockpits under transparent canopies, one movable and two fixed machine-guns, and normal bombload of one 250-kg (551-lb) weapon on swinging arms, plus two 60-kg (132-lb) under the outer wings. Carrier trials were flown in August 1940, and substantial numbers of D3A1s were operational from land bases in China and Indo-China from October 1940.

At Pearl Harbor, 126 aircraft dive-bombed targets with great accuracy, and were the only type in the first wave of attackers. Subsequently the D3A1, or Type 99 carrier-based bomber Model 11, was in the forefront of Pacific battles, receiving the Allied code name 'Val'. In April 1942 a very small force sank the cruisers HMS *Dorsetshire* and *Cornwall* and the carrier *Hermes*, achieving direct hits with more than four bombs out of five. But in the battles of the Coral Sea, off Guadalcanal, Santa Cruz and the Solomons, both the D3A1 and the Japanese aircraft carriers suffered such crippling losses that only a handful of the skilled and experienced crews remained. Subsequently the D3A was not considered such a danger.

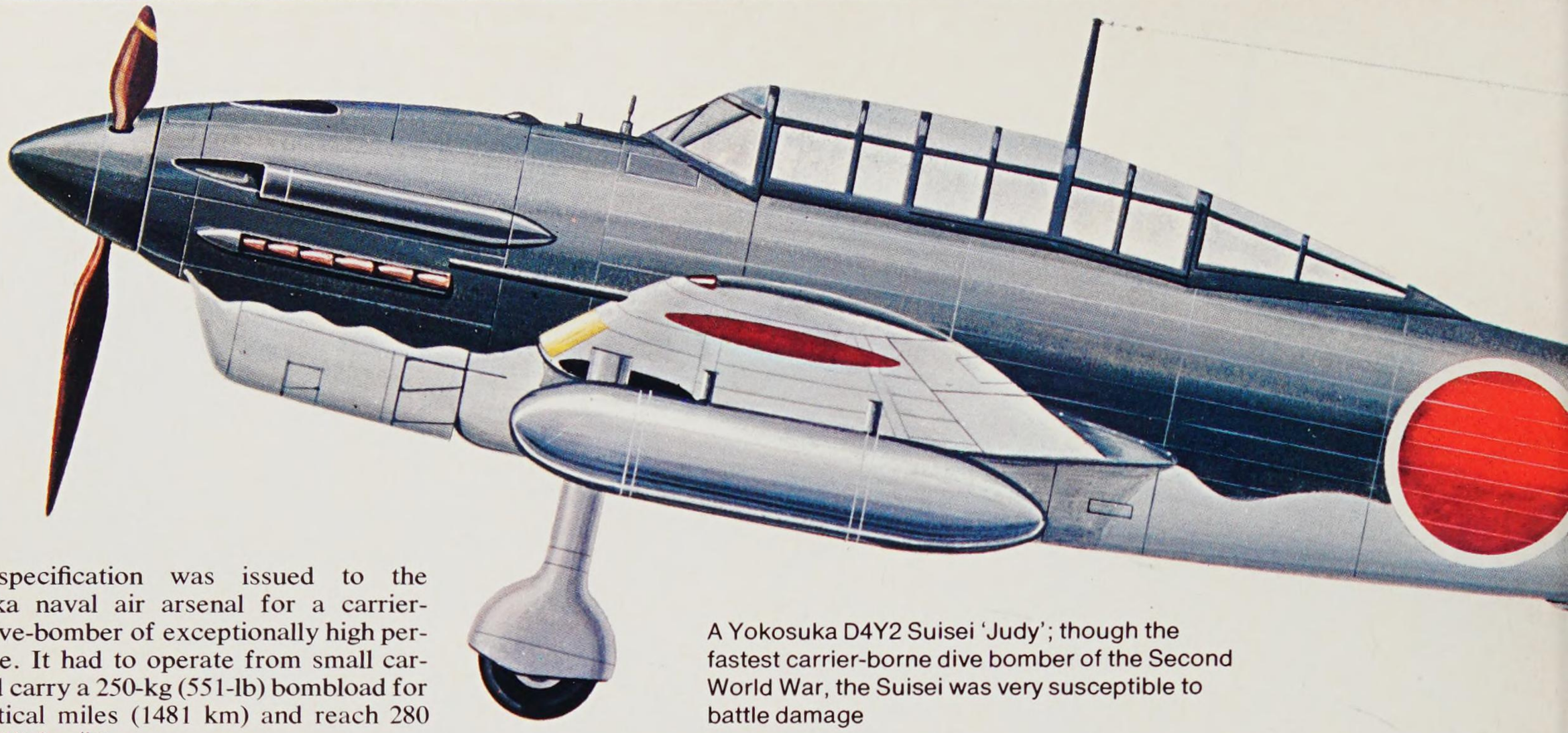
In June 1942 production switched to the better-streamlined D3A2, with 1300-hp Kinsei 54, and increased fuel capacity. Aichi built a total of 816 of this model, the Type 99 Model 22, by June 1944, and Showa also built 201 by the end of the war. Like all Japanese warplanes of the post-1942 period, the D3A2 had no chance. Nearly all operated from land airstrips, suffered severe losses and accomplished little. By mid-1944 most were in use as trainers (D3A2-K), but large numbers were then reassigned to front-line duty in the Kamikaze role.

Span: 14.365 m (47 ft 1½ in) *Length:* 10.195 m (33 ft 5½ in) *Gross weight:* (D3A2) 3800 kg (8377 lb) *Maximum speed:* (D3A2) 430 km/h (267 mph)

D4Y Suisei, Yokosuka

Japanese naval dive-bomber and night fighter. Influenced by flight tests with a Heinkel He 118 in 1938, the Japanese navy decided that future carrier-based aircraft should be much cleaner aerodynamically. A 13-Shi

D 9, Dewoitine



A Yokosuka D4Y2 Suisei 'Judy'; though the fastest carrier-borne dive bomber of the Second World War, the Suisei was very susceptible to battle damage

(1938) specification was issued to the Yokosuka naval air arsenal for a carrier-based dive-bomber of exceptionally high performance. It had to operate from small carriers and carry a 250-kg (551-lb) bombload for 800 nautical miles (1481 km) and reach 280 knots (519 km/h).

The prototype D4Y1 flew in December 1940, and achieved excellent performance despite having only a 960-hp DB 600G. However, it was not until March 1942 that the first production D4Y1 emerged from the Aichi factory at Nagoya (the Allies later thought this an Aichi design). Powered by the 1200-hp Aichi AE1A Atsuta 12 inverted-V-12 (licence-built modified DB 601A) the aircraft had such speed and range it was ordered as the D4Y1-C reconnaissance aircraft, with rear fuselage camera(s) and underwing drop tanks, and the -C model remained in use until Japan's final surrender.

Work continued to perfect the basic D4Y1 and eventually it entered service in March 1943. Production amounted to 660 by Aichi, with the Japanese name Suisei (Comet) and the Allied code-name 'Judy', but in the first big action at the Marianas 'turkey shoot' they suffered severe casualties at the hands of US Navy fighters and failed to sink any major warships. Their chief faults were complete absence of armour or self-sealing tanks and the feeble armament of two fixed 7.7-mm (0.303-in) Type 97 machine-guns in the nose and a 7.92-mm (0.312-in) Type 1 aimed by the radio operator/navigator/gunner in the rear seat. Normal bombload was 310 kg (683 lb), but for short ranges 560 kg (1234 lb) could be accommodated.

Like many of the best Japanese aircraft of the Second World War, the D4Y had the misfortune to enter service just as the era of Japanese superiority was coming abruptly to an end. The fleet carriers were fairly soon all sent to the bottom of the Pacific, and most of the total of 2038 of all versions of D4Y operated from escort carriers and shore bases, often in roles quite different from those for which the type was designed. The first new sub-type, other than the -C, was the D4Y2, which had the 1400-hp Atsuta 32 engine and, in the main D4Y2a variant, a 13-mm (0.51-in) Type 2 gun in the rear cockpit. Entering service just in time for the Leyte Gulf and Philippines battles in October 1944, the new model was coolly received, because it still had neither armour nor tank protection. Aichi built 326, plus about 100 by Dai-Juichi Kaigun Kokusho (Hiro Naval Air Arsenal), but they were shot out of the sky and soon appeared as kamikaze suicide attackers, usually with an 800-kg (1764-lb) bombload, carried externally.

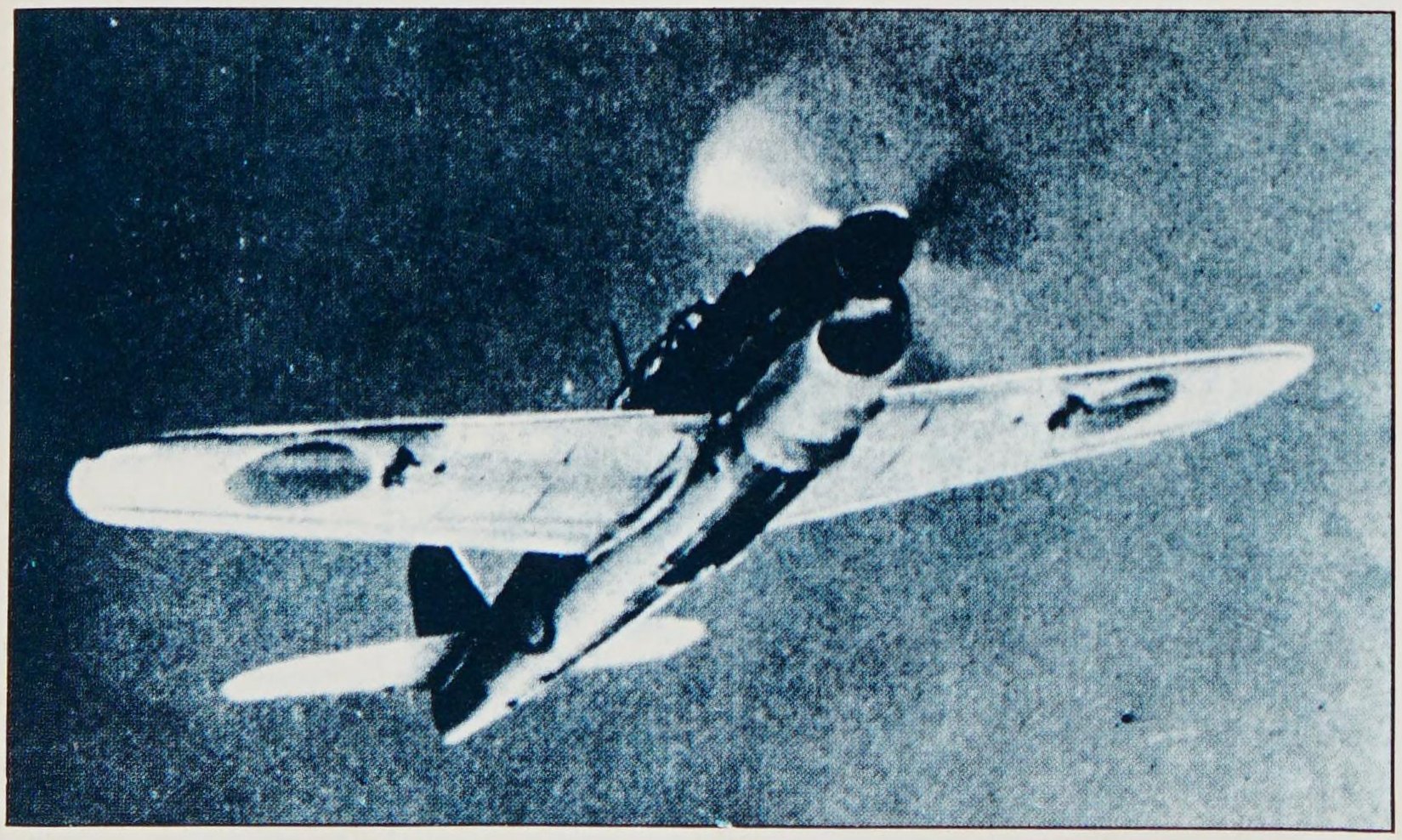
From the start the liquid-cooled engine had been unpopular, owing to its difficult maintenance and poor reliability. The general feeling about the trim Suisei had been that there was not much wrong with it that proper protection and a radial engine would not cure, and in the winter of 1943/4 the Aichi team schemed an installation for the 14-cylinder two-row Mitsubishi Mk8P Kinsei 62.

The D4Y3 prototype, flown in May 1944, showed acceptable handling qualities and almost identical performance to the earlier models, with marginally lower speed but longer range and improved takeoff and climb capability. Production was authorized at once, and both Aichi and Hiro arsenal delivered a total of about 350 in all. Amazingly, these still did not have any protection for crew or fuel, and only the later D4Y3a had a 13-mm (0.51-in) rear gun. Most had provision for catapulting but as there were virtually no carriers, the majority were also equipped to have three RATO rockets clipped below the rear fuselage to assist takeoff from island airstrips.

The last sub-type was the D4Y4, a purpose-designed kamikaze aircraft. A single-seater, it carried an 800-kg (1764-lb) bomb or explosive charge (made from a mine or torpedo) semi-externally. Though 296 were delivered by Aichi in 1945, few if any photographs exist. The proposed D4Y5, with 1825-hp NK9C Homare engine and proper armour and protected tanks, did not fly. The D4Y2 was later converted to a night fighter.

(D4Y3) *Span:* 11.5 m (37 ft 8¾ in) *Length:* 10.22 m (33 ft 6½ in) *Gross weight:* 4657 kg (10 267 lb) *Maximum speed:* 575 km/h (357 mph)

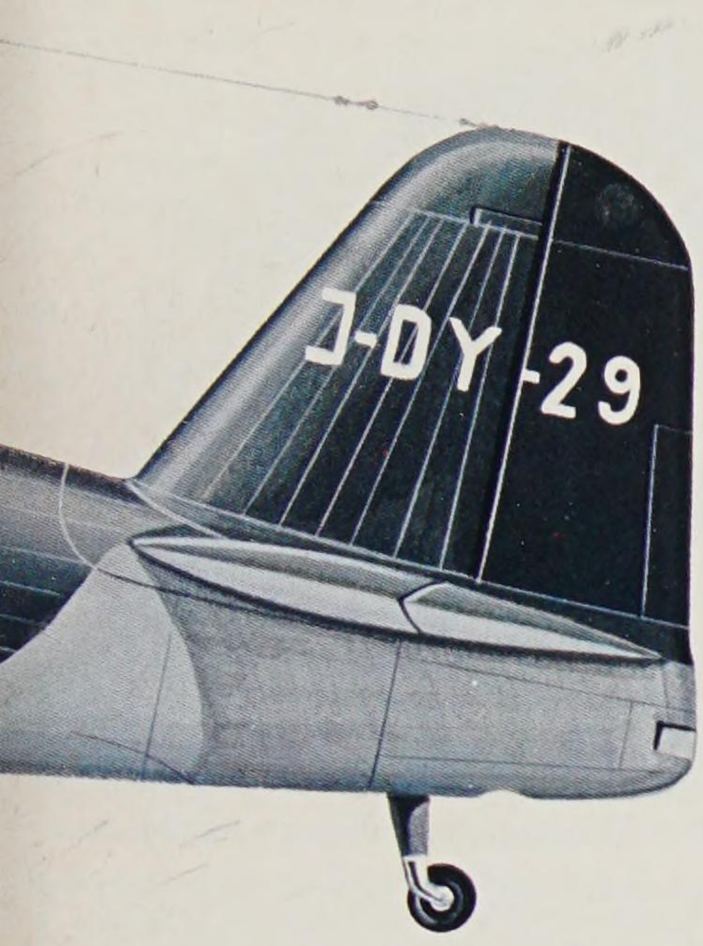
A D4Y2 'Judy' in flight showing the deep chin radiator air intake for the Aichi AE1A engine

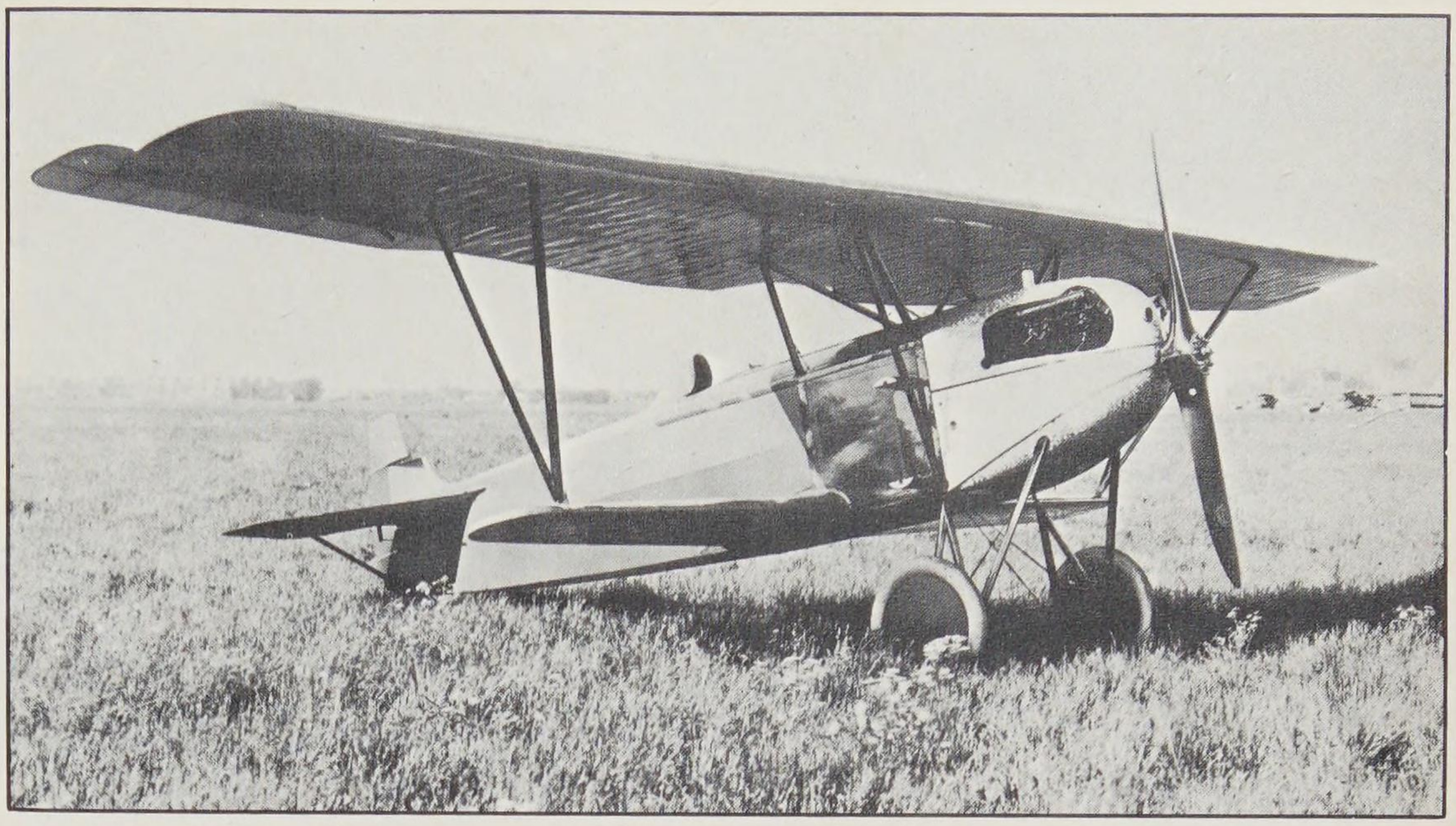


Fujiphoto

D 9, Dewoitine

French fighter aircraft. First flown in 1924, the Dewoitine D 9 was essentially a scaled-down development of the earlier D 1 single-seat parasol monoplane fighter, from which it differed mainly in being powered by a 420-hp Gnome-Rhône 9 Ac radial engine, a licence-built version of the 9-cylinder Bristol Jupiter.





Fokker

The Fokker D.XI (PW-7) was developed by Anthony Fokker using experience gained in the First World War. Some 125 went to the Russians for covert training of German pilots during 1925-33

Armament was increased to four 7.5-mm (0.295-in) machine-guns, the second pair being positioned in the wing leading-edge outside the area of the propeller disc.

Two prototypes were completed, of which the Aviation Militaire purchased one for evaluation, but despite the extra available power the performance was not significantly improved—the D 9 took only 9 seconds less than the D 1 to reach 5000 m (16 404 ft)—and no French production contracts resulted.

Apart from the prototypes, only 13 were manufactured by Dewoitine, for Belgium (two), Switzerland (which acquired the second prototype and assembled three others in 1928 from French-built components), and Yugoslavia (eight). The largest production was undertaken by Ansaldo in Italy, which built 147 for the Regia Aeronautica with the designation AC 3.

Span: 10.85 m (35 ft 7¼ in) *Length:* 6.90 m (22 ft 7¾ in) *Gross weight:* 1491 kg (3287 lb) *Maximum speed:* 232 km/h (144 mph)

D.XI, Fokker

Dutch fighter aircraft. After the Armistice in 1918, Anthony Fokker returned to Holland and began rebuilding his aircraft manufacturing company, initially utilizing components and airframes smuggled back from Germany. He began to develop a new series of fighter designs originating from the highly successful D.VII of First World War fame. One of the first to appear, in prototype form only, was the D.IX, powered by a 300-hp Hispano-Suiza engine. It attracted little attention, except from the USAAC which evaluated it under the designation PW-6.

The D.IX was, however, used as the design basis for the D.XI, a single-bay, unequal-span biplane of sesquiplane configuration. Powered by the 300-hp Hispano-Suiza liquid-cooled engine of the D.IX, it was armed with two forward-firing machine-guns mounted in the engine cowling in front of the cockpit. It first flew on May 5, 1923.

The main order received (for 125) was from the USSR, where German pilots were being secretly trained during 1925-33 with a view to the future formation of the Luftwaffe. Three were supplied to the USAAC and tested as PW-7s with the 440-hp Curtiss D-12 engine. A total of 177 D.XIs were built, the others going in varying small quantities to the Argentine, Romania, Spain and Switzerland.

Span: 11.60 m (38 ft 0¾ in) *Length:* 7.00 m (22 ft 11½ in) *Gross weight:* 1250 kg (2756 lb) *Maximum speed:* 225 km/h (140 mph)

D.XIII, Fokker

Dutch fighter aircraft. As a follow-up to the production of the D.XI, the prototype D.XII was flown on August 21, 1924, powered by a 385-hp Curtiss V-1150 engine and having fabric instead of plywood-covered wings. However, it was not accepted by the USAAC, towards whom it had been directed, and like the D.IX, was used as a basis for another design, the D.XIII single-seat fighter. This first flew on September 12, 1924, powered by a 425-hp Napier Lion 12-cylinder liquid-cooled engine, over which twin machine-guns were mounted.

The 50 of these aircraft built went to the clandestine German Jagdlehrstaffel (fighter training squadron) at Lipezk in the USSR, ordered on their behalf by the Russians. The D.XIII also set up four international speed records in 1925 with 250-kg (551-lb) and 500-kg (1102-lb) payloads.

Span: 11.00 m (36 ft 1½ in) *Length:* 7.90 m (25 ft 11 in) *Gross weight:* 1650 kg (3638 lb) *Maximum speed:* 257 km/h (160 mph)

D.XVI and D.XVII, Fokker

Dutch fighter aircraft. Since the Luchtvaartafdeling (Netherlands air force) had rejected the D.XI and D.XIII designs, by the late 1920s it was in desperate need of a more modern fighter to replace the now-ageing D.VIIs. In 1928 the D.XVI was developed from a Fokker design (D.XV/D.XVa). It first flew in 1929, powered by a 450-hp Armstrong Siddeley Jaguar engine.

Fifteen production models were ordered by the Dutch air force. Their engines were fitted with Townend rings and they were armed with twin 7.5-mm (0.295-in) machine-

A Fokker D.XIII; 50 of these fighters went to the secret German squadron at Lipezk in the USSR

Fokker

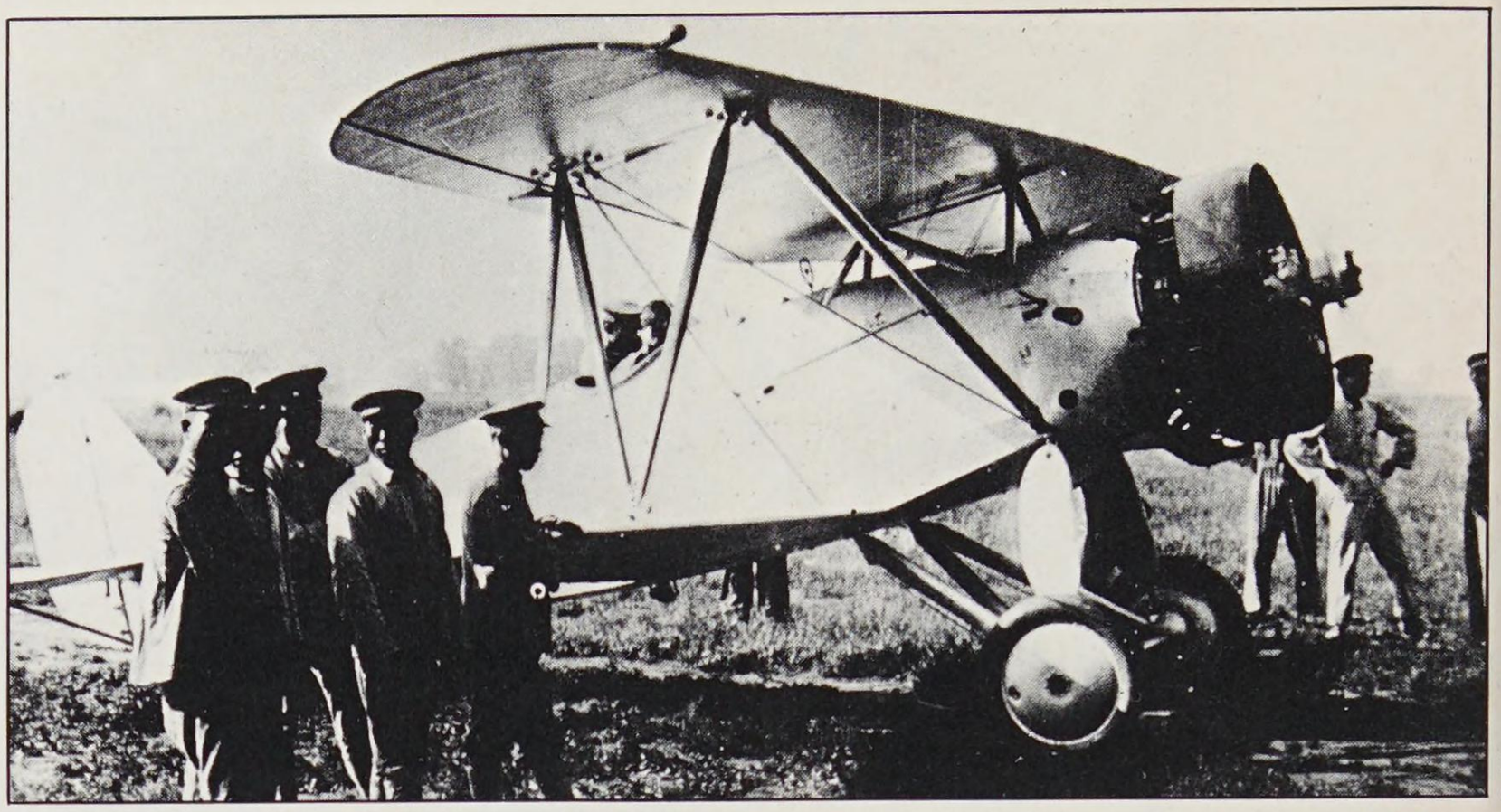
guns in the upper front fuselage. Six others were exported—to China (one), Hungary (four, with Bristol Jupiter engines) and Italy (one).

The first flight in 1931 of another D.XVI prototype, fitted with a Curtiss Conqueror V-1570 engine, was with the object of finding a D.VII replacement for the Dutch East Indies army air service, but no orders were forthcoming. In 1932 it reappeared, with some modifications, as a new prototype designated D.XVII. Dutch East Indies army air service lacked the funds to purchase it, and only 11 were ordered, these by the LVA. They were powered variously by 595-hp Rolls-Royce Kestrel, 690-hp Hispano-Suiza 12 Xbrs or 790-hp Lorraine Petrel engines. The armament was the same as for the D.XVI. Six of these aircraft, Fokker's last biplane fighter, were still in LVA service as trainers in May 1940.

(D.XVII) *Span:* 9.60 m (31 ft 6 in) *Length:* 7.20 m (23 ft 7½ in) *Gross weight:* 1480 kg (3263 lb) *Maximum speed:* 335 km/h (208 mph)

D.XXI, Fokker

Dutch fighter aircraft. Designed initially in 1935 by Schatzki of the Fokker company for the Dutch East Indies army air service, the D.XXI was a low-wing monoplane, with enclosed cockpit and fixed, spatted undercarriage. It had a 350-litre (77-Imp gal) fuel tank behind the engine and supplementary tanks could be installed in the wings. The intended powerplant was the 650-hp Rolls-Royce liquid-cooled Kestrel V-type engine, but when the prototype first flew on March 27, 1936, it utilized a 645-hp Bristol Mercury VIS radial engine.



Above: **A Fokker D.XVI during trials in China.** ***Below:*** **A D.XVII, Anthony Fokker's last biplane**

A Fokker D.XXI in Finnish service during the Continuation War against the Soviet Union. The swastika markings were Finnish, while the yellow band on the fuselage indicated an aircraft of the Axis forces serving on the Eastern Front

The first government contract, for 36 aircraft, was issued in the summer of 1937. These were to be powered by 830-hp Bristol Mercury VII or VIII engines, and armed with two 7.92-mm (0.312-in) FN-Browning machine-guns in the wings and two firing through the propeller disc. Delivery began on July 20, 1928, and the last aircraft arrived for service one week after Germany invaded Poland, on September 8, 1939. Twenty-nine of this batch, equipping the 1st, 2nd and 5th Fighter Groups of the LVA, were serviceable when Holland was invaded. They acquitted themselves well, but had to be grounded after only three days fighting, due to lack of ammunition.

During 1937 the Finnish government purchased seven D.XXIs (Mercury VIII-engined) and 93 were manufactured in Finland under licence between 1939-44. Thirty-eight of these were Mercury-engined; the remainder were redesigned in Finland to accept 825-hp Pratt & Whitney R-1535-SB4G engines, and had all four guns relocated in the wings. In July 1937 the Danish government bought two D.XXIs and produced ten under licence in that country with the Mercury VIII engine. These were in service when Denmark was invaded in 1940, one being experimentally equipped with two 20-mm (0.79-in) Madsen cannon in underwing blisters; the others were armed with two 8-mm (0.315-in) DISA machine-guns in the upper front fuselage. Spain obtained a manufacturing licence, but the plant at Carmoli was bombed during the Civil War and it is doubtful if any of its aircraft were ever completed.

Span: 11.00 m (36 ft 1½ in) *Length:* 8.21 m (26 ft 11¼ in) *Gross weight:* 2050 kg (4519 lb) *Maximum speed:* 460 km/h (286 mph)

D 21, Dewoitine

French fighter aircraft. In the mid-1920s Emile Dewoitine designed a number of single-seat parasol fighters developed from his original D 1 of 1921. Following the D 9 came the larger D 12, powered by a 450-hp Lorraine 12 Eb engine and armed with two 7.5-mm (0.295-in) wing-mounted Darne machine-guns. In 1925 Dewoitine produced the D 19, with a 450-hp Hispano-Suiza 12 Jb. Neither

A line of LVA D.XXIs. The type performed well during 1940

was adopted by the French government, but following a demonstration of the D 19 in Switzerland in August 1925, three examples of this aircraft were completed in that country by the EKW state aircraft factory at Thun.

Slightly more success, at least in foreign markets, attended the Dewoitine D 21, which had four 7.5-mm (0.295-in) Darne machine-guns arranged as those of the D 9, and was powered by a 500-hp Hispano-Suiza 12 Gb V-12 engine. Licence production of this aircraft was undertaken in Argentina (58) and Czechoslovakia (25) in the late 1920s.

One French-built D 21 was sold to Switzerland, where in late-1926 Emile Dewoitine had taken up residence, his French company having been bankrupted by the lack of domestic orders for any type since the D 1, and where, in 1928, there appeared the final development of the D 1 formula, the D 27.

Span: 12.80 m (42 ft 0 in) *Length:* 7.93 m (26 ft) *Gross weight:* 1580 kg (3483 lb) *Maximum speed:* 267 km/h (166 mph)

D 27, Dewoitine

French fighter aircraft. Representing the ultimate development of the parasol monoplane formula originated with the D 1, the Dewoitine D 27 was designed in Switzerland and built there by the EKW state aircraft factory at Thun. It first flew in 1929, with an SLM-Saurer-built Hispano-Suiza 12 Mc engine of 600 hp, and a total of 85 were built at Thun between 1929-33.

Sixty-six of these were delivered from 1930 to the Swiss Fliegertruppe, which also received 11 examples of the D 26, a version fitted with a 250-hp Wright Cyclone radial engine. Fifty-six of the Swiss D 27s were still in first-line fighter squadron service when war broke out in 1939. During the following year they were withdrawn to training units, from which they did not disappear completely for another decade. The D 27 was armed with twin 7.5-mm (0.295-in) machine-guns and could climb to its service ceiling of 8300 m (27 231 ft) in 11 minutes.

Dewoitine was, however, still without success in his native France, where he had submitted the design for yet another fighter competition. Five prototypes, designated D 271 to D 275, were ordered, having either Hispano-Suiza or Gnome-Rhône engines. Again, no French government orders materialized, perhaps because the D 27 was some 70% costlier than its chief competitor, the Nieuport-Delage 622. However, the five prototypes and two of a strengthened model, the D 53, were flown experimentally for a time on board the aircraft carrier *Béarn*.

In January 1930 the D 27 competed—again unsuccessfully—in a Belgian air force fighter competition. Some consolation was forthcoming later in that year, however, for on November 30, Dewoitine chief test pilot Doret broke the world 1000 km (621 mile) closed-circuit speed record flying a Dewoitine D 27 at an average of 286.227 km/h (177.854 mph).

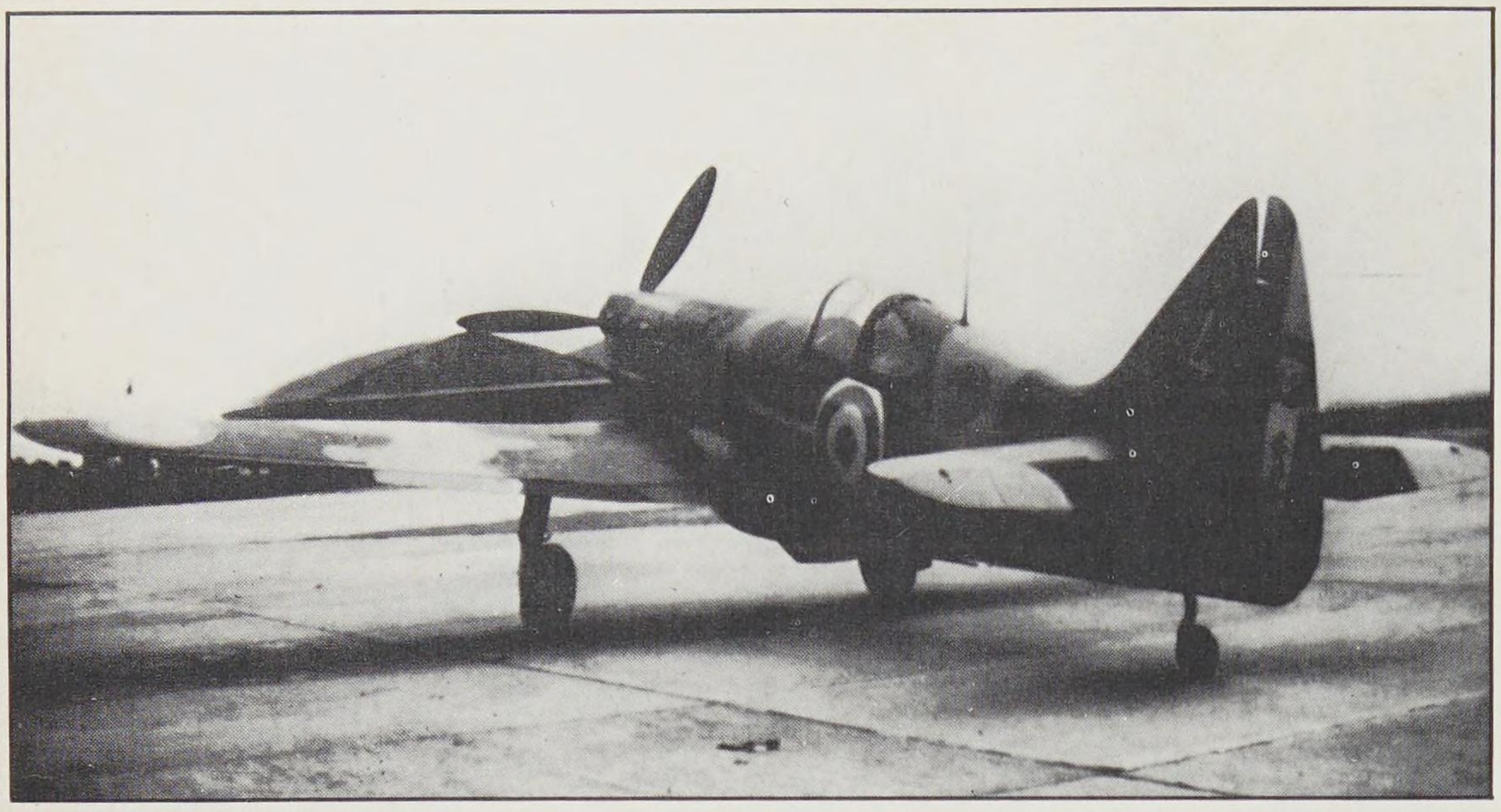
Span: 9.80 m (32 ft 1¾ in) *Length:* 6.50 m (21 ft 4 in) *Gross weight:* 1370 kg (3020 lb) *Maximum speed:* 310 km/h (193 mph)

D 37, Dewoitine

French fighter aircraft. Evolved in 1931 in parallel with the D 500, the D 37 was developed via the D 53 (strengthened D 27) and first flown in August 1932 with a 700-hp Gnome-Rhône 14 Kbrs radial engine driving a four-blade propeller. The prototype was built at Argenteuil by Lioré et Olivier and was entered for the 1932 French fighter competition by the Société Aéronautique Française, a new company formed by Emile Dewoitine following his return from Switzerland.

Four versions were built, beginning in 1934 with 28 D 31s for the Armée de l'Air with 800-hp Gnome-Rhône 14 Kds engines. These entered service from 1935 with GC (Groupe de Chasse) II/4 in France and ERC (Escadrille Régionale de Chasse) 574 in Tunisia. In 1936 ten of these aircraft were reallocated to the Republican forces in Spain, which also received 14 D 372s (930-hp Gnome-Rhône 14 Kfs) ordered by Lithuania. In March 1936, Escadrilles 7C1 and 7C2 of the Aéronavale at Hyères began to replace their Wibault 74s with 20 examples of the D 373, similar to the 372 except for wing flaps and deck landing gear; and these were followed by 25 D 376s with wing folding.

D 500/501/510, Dewoitine



ECP Armées

A Dewoitine D 520 of Flotille 7C of the Aéronavale; orders up to April 1940 were for 2200 for the Armée de l'Air and 120 for the Aéronavale, but only 36 D 520s were in service in May 1940

Standard armament of the D 37 was four underwing 7.5-mm (0.295-in) MAC 1934 or Darne machine-guns, but the D 371 prototype was a testbed for two long-barrelled 20-mm (0.79-in) Oerlikon S cannon mounted in the wing centre-section, and some D 373/376s were fitted with 13.2-mm (0.520-in) Hotchkiss machine-guns. Performance of the D 371 included a climb to 4500 m (14 764 ft) in 5.18 minutes and to 10 000 m (32 810 ft) in 21.85 minutes.

This version's service effectiveness was limited, due to extensive grounding brought about by frequent engine troubles, and those still serving with ERC 574 in Tunisia were replaced by Morane-Saulnier 406s in November 1940. The D 373/376s, 27 of which constituted the entire Aéronavale fighter strength upon the outbreak of war, were similarly replaced by Potez 63 fighters in January 1940.

(D 371) *Span:* 11.80 m (38 ft 8½ in) *Length:* 7.44 m (24 ft 5 in) *Gross weight:* 1725 kg (3803 lb) *Maximum speed:* 380 km/h (236 mph)

D 500/501/510, Dewoitine

French fighter series. The D 500 was designed by Emile Dewoitine to a 1930 requirement for the Aviation Militaire. It was of all-metal monoplane construction, with neat cantilever low wings, a fixed, spatted landing gear, open cockpit, powered by a 500-hp Hispano-Suiza 12 Xbrs liquid-cooled V-engine, and carrying 7.5-mm (0.295-in) wing-mounted Darne cannon.

The prototype was first flown on June 18, 1932, and a series of fighters developed from this, of which 308 examples were built. The first contracts, placed by the French government in November 1933, were for four prototypes and 11 production D 500/501s from Dewoitine, with 40 D 500s and five D 501s from the Lioré et Olivier company, which eventually built most of the aircraft produced, others being built by Loire.

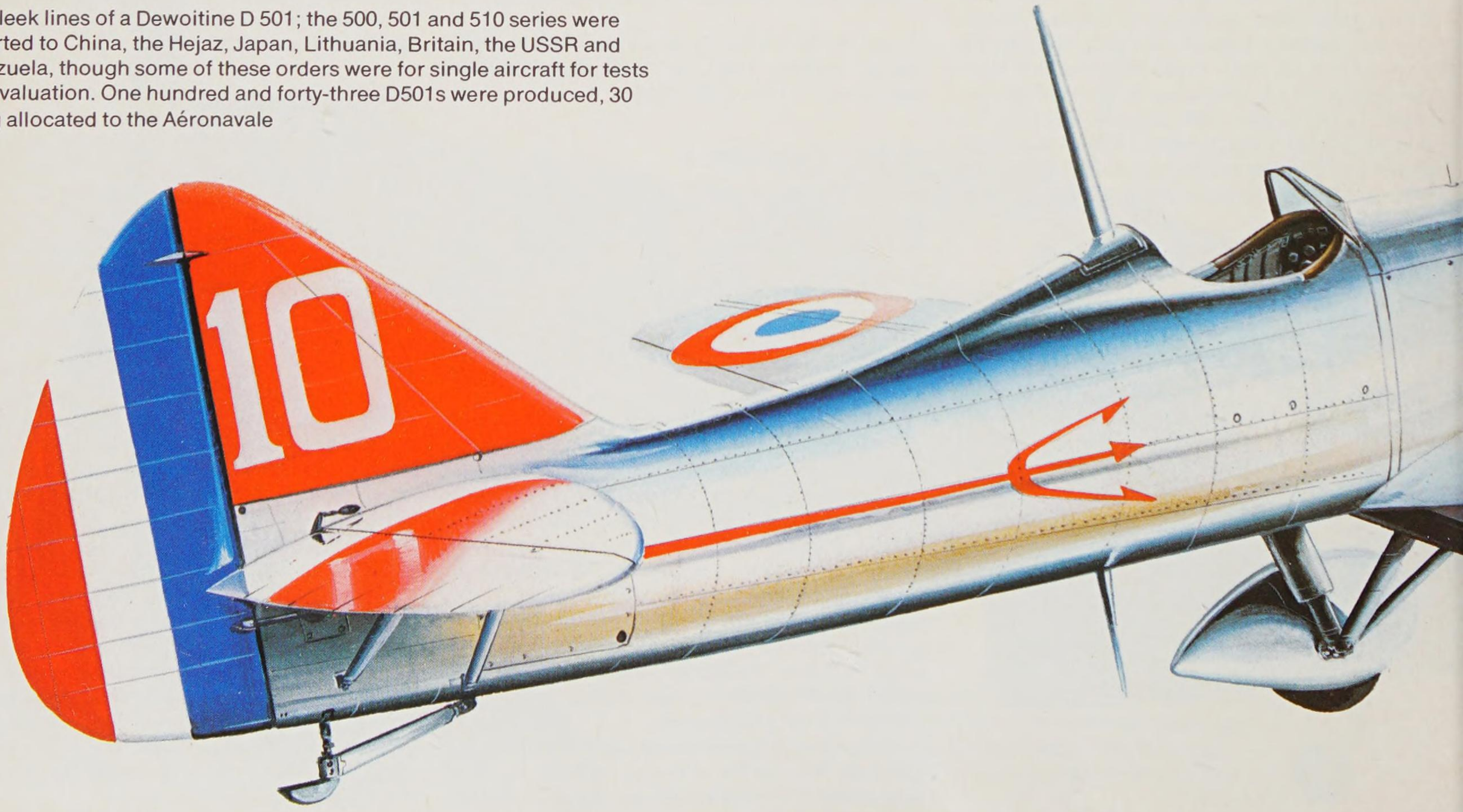
The D 501 was powered by the 650-hp Hispano-Suiza 12 Xcrs, the *moteur-canon* version of which mounted a 20-mm (0.79-in) Hispano cannon between the cylinder banks to fire through the hub of the spinner. D 500 deliveries to the Armée de l'Air (as it was known by then) began in the spring of 1935, and 97 were eventually received. One hundred and forty three D 501s were also produced, including 30 for the Aéronavale.

A further-improved model, the D 510, first flew on August 14, 1934. It had a larger-area rudder and a revised engine mounting to accommodate the 860-hp HS 12 Ycrs powerplant. One hundred and twenty were built, 90 going to the Armée de l'Air, for whom the D 510 was the first fighter capable of a level speed exceeding 400 km/h (248 mph).

Before the Second World War, most D 510s served in metropolitan France or Tunisia but on the outbreak of war, Groupes de Chasse GC I/1, II/1 and I/8 were equipped with this model, and some D 501s were still in service in France with ERC (Escadrilles Régionales de Chasse) 561 and 562. Some D 501s were also still in service in North Africa when France capitulated in May 1940.

Prior to the outbreak of war, Dewoitine had export orders from China (24 D 510C), the Hejaz (two D 510), Japan (two D 510J), Lithuania (14 D 510L), Britain (one D 510A), the USSR (one D 510R) and Venezuela (three D 500V). There is some doubt whether those destined for Venezuela were ever received,

The sleek lines of a Dewoitine D 501; the 500, 501 and 510 series were exported to China, the Hejaz, Japan, Lithuania, Britain, the USSR and Venezuela, though some of these orders were for single aircraft for tests and evaluation. One hundred and forty-three D501s were produced, 30 being allocated to the Aéronavale



A Dewoitine D 520 of the Jeanne d'Arc squadron in service in France in 1940. The D 520 was one of the few modern aircraft available to the French in May 1940, and though they performed well against the Luftwaffe with a two-to-one kill ratio their numbers were insufficient to hamper German air attacks. They also saw action with the Vichy air force against RAF fighters, and were used as trainers by the Germans in Russia

and it is probable that some or all of the Lithuanian batch and the two for the Hejaz went instead to the Republican forces in Spain during the Civil War.

(D 510) *Span:* 12.092 m (39 ft 8 in) *Length:* 7.94 m (26 ft 0½ in) *Gross weight:* 1920 kg (4233 lb) *Maximum speed:* 393 km/h (244 mph)

D 520, Dewoitine

French fighter aircraft. The Dewoitine company was nationalized in 1936, becoming part of the SNCAM (Société Nationale de Constructions Aéronautiques du Midi), and on the outbreak of the Second World War the D 520, designed by Robert Castello, was the French air forces's most advanced fighter. Three prototypes were ordered by the French government in April 1938, the first (D 520-01), powered by an 860-hp Hispano-Suiza 12Y-21 engine, flying on October 2 of that year. With this powerplant the aircraft did not achieve its required speed of 520 km/h (323 mph), but with an uprated 12Y-29 engine with jet exhaust manifold, the design speed (from whence came the D 520's designation) was reached.

The second prototype (D 520-02) with a redesigned tail and other aerodynamic improvements flew for the first time on January 28, 1939. It was fitted with a provisional armament of one HS 404 20-mm (0.79-in) Hispano cannon firing through the propeller hub and two 7.5-mm (0.295-in) MAC 1934-M39 machine-guns in underwing fairings. It was powered by a 12Y-29 (later 12Y-31) and reached a speed of 550 km/h (342 mph). The D 520-03 third prototype was similar to the second, and first flew on March 15, 1939. It had a steerable tail-wheel instead of the tail-skid of the other two aircraft.

The first production example, from an initial order for 200 placed in April 1939, flew on November 2, 1939, powered by a 930-hp Hispano-Suiza 12Y-45 engine. Orders up to April 1940 required 2200 for the Armée de l'Air and 120 for the Aéronavale, but many were cancelled due to difficulties in maintaining the production rate. The fuselage of the production machines was lengthened by 51 cm (20 in), the engine cowling was modified, two additional fuel tanks were fitted within the wing leading-edges and armour protection was provided for the pilot. The armament was increased by a further two 7.5-mm (0.295-in) M39 guns enclosed in the wings.

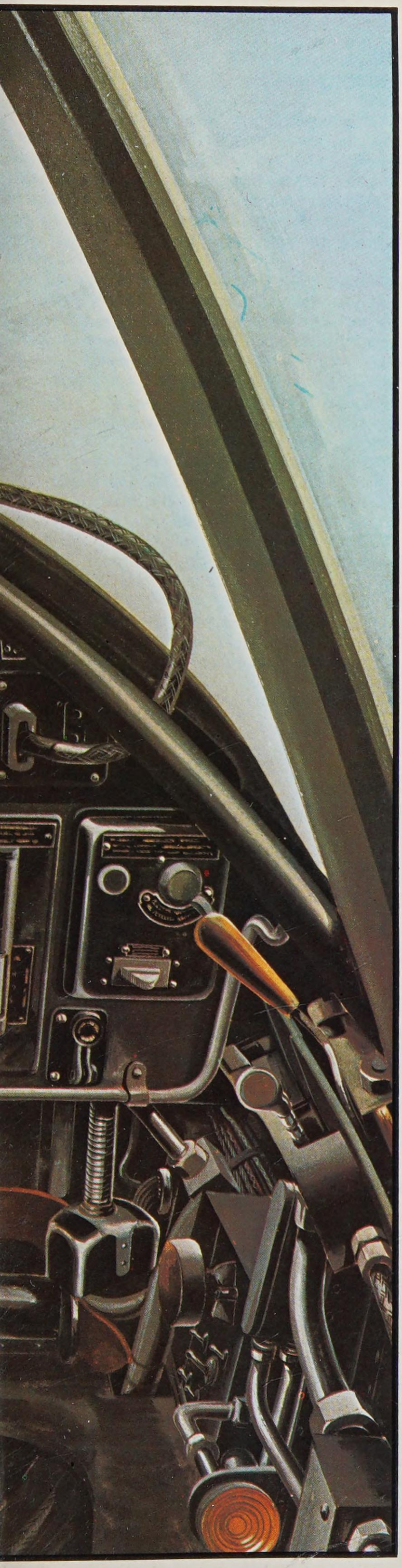
Deliveries began in January 1940, but when the German armed forces made their attack against France on May 10, 1940, only 36 D 520s, equipping GC I/3, were in service. They flew their first operational sorties three days later and proved extremely effective under fire, establishing a 2/1 'kill ratio' over Luftwaffe opponents. As deliveries increased, D 520s served with five Groupes de Chasse during May and June, and by June 25, 1940, a total of 437 had been completed.

After the armistice with France, Germany permitted her a limited air arm (Armistice air force), but there were no D 520 units in the occupied country. Over 300 aircraft, however, remained in unoccupied France and North Africa and were used by the Vichy French air force.

The German authorities ordered a further 550 D 520s to replace all other single-engined fighters in French service, and, although they saw considerable action against many British aircraft, their losses were few. In November 1942 the Germans entered the hitherto 'Free' French areas and commandeered 246 D 520s plus a further 169 in various stages of production. The SNCA de Sud-Est received a contract from the Germans to complete 150 of these machines, and by the summer of 1944 they had been delivered, bringing total D 520 production to 905 machines. A few of these were used as trainers by the Luftwaffe Jagdgeschwadern in the USSR, and D 520s also equipped JG 105 at Chartres, JG 103 in Austria and JG 101 in Pau Long. Sixty D 520s were allocated to the Regia Aeronautica as trainers and second-line fighters; 120 formed the basic strength of the Bulgarian air arm, and a few saw service with the Romanian air force.

As the Germans retreated in the autumn of 1944, the liberated French recaptured about 75 D 520s. These helped reform the French air force on December 1, 1944, and they flew with the Forces Françaises de l'Interieur

D 520, Dewoitine



during the closing months of the war. In late 1945, one of the 17 Dewoitines still in use as trainers at Tours was converted to two-seat configuration and designated D 520 DC; 12 were thus modified.

Some D 520s were phased out of service through lack of spares in mid-1948 and the last unit was disbanded in September 1953. This aircraft had been originally designed to accept a 1300-hp engine, in order to reach a speed of 595 km/h (370 mph), but no reliable engine of this power was ever available for trial or production aircraft.

Span: 10.20 m (33 ft 5¾ in) *Length:* 8.76 m (28 ft 8¾ in) *Gross weight:* 2783 kg (6135 lb) *Maximum speed:* 525 km/h (326 mph)

D-3800, Dornier/F&FW

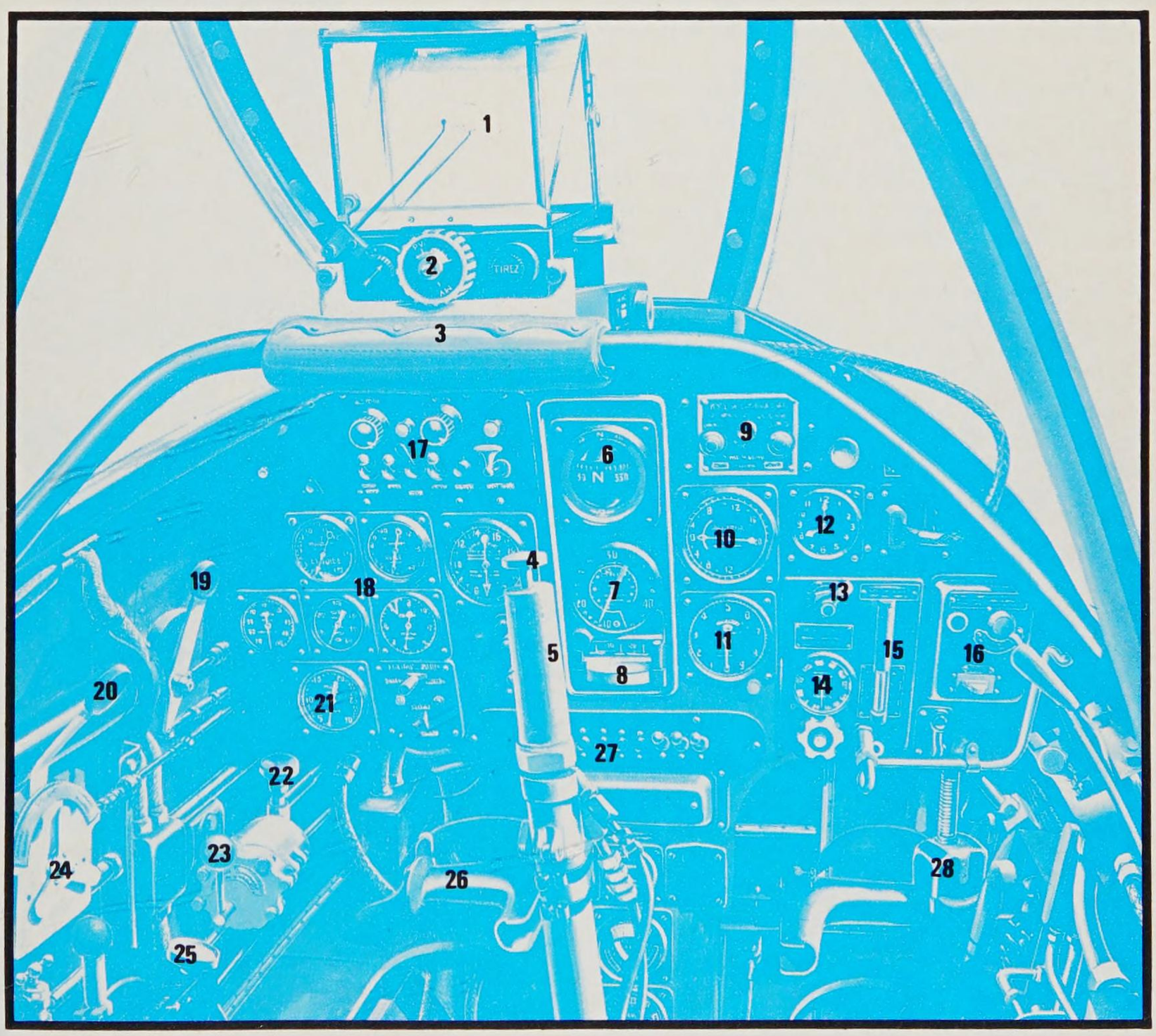
Swiss fighter aircraft. In 1938 the Swiss government purchased two Morane-Saulnier M.S.405 fighters from France and, after careful evaluation, purchased a licence for the production version, the M.S.406. Manufacture of a Swiss version of the 406 was assigned to Dornier-Flugzeug at Altenrhein, with the Swiss designation D-3800. This differed from the French aircraft in having a Saurer/SLM licence-built Hispano-Suiza 12Y-31 of 860 hp, cooled by a fixed ventral radiator. In 1939-40 Dornier delivered 82, followed in 1940-44 by 207 D-3801 fighters with many refinements and a Saurer/SLM-built HS 12Y-51 of 1000 hp. Both types had one 20-mm (0.79-in) Hispano cannon and two 7.7-mm (0.303-in) wing guns, with provision for two 50-kg (110-lb) bombs.

From the French M.S. 450 Dornier derived the D-3802 in 1943, with a 1250-hp 12Y-52 in a significantly different airframe, with three 20-mm (0.79-in) cannon. Only ten were built in 1944, and the 1500-hp (12Y-53) D-3803 of 1947 remained a one-off, by which time the company had become Flug & Fahrtzeugwerke (F&FW).

(D-3801) *Span:* 10.61 m (34 ft 9¾ in) *Length:* 8.16 m (26 ft 9¼ in) *Gross weight:* 2725 kg (6007 lb) *Maximum speed:* 523 km/h (325 mph)

'Dackel'

German torpedo, otherwise known as the T3d type. The Dackel (slow-worm) was a pattern-running weapon for use against shipping in harbours. The basic weapon was the electric T3 type, known in service as the G7e,



Dewoitine D 520 Cockpit

1. Gunsight
2. Sight Adjustment
3. Head Stop
4. Firing Button
5. Control Stick
6. Compass
7. Air Speed Indicator
8. Artificial Horizon
9. Ignition
10. Altimeter
11. Direction Indicator
12. Clock
13. Fuel Cock
14. Fuel Gauge
15. Hydraulics
16. Radio Selector
17. Switch Panel
18. Control Dials
19. Flaps Lever
20. Undercarriage Lever
21. Pressure Indicator
22. Mixture Control
23. Throttle Control
24. Locking Control
25. Radiator Flap Lever
26. Rudders
27. Switch Panel
28. Rudder Adjustment

the standard U-Boat weapon, but several modifications were made. By redesigning the battery, 125 ampere hours could be obtained instead of 93 ampere hours from the original 13T210 battery. By reducing the speed from 30 knots to 9 knots it was possible to give the T3d variant a range of over 35 miles, hence its nickname 'slow-worm'.

The Dackel was fired into a bay or anchorage, and could be set to circle or zigzag for a total of four hours! Being about 2 m (6 ft) longer than a G7e torpedo it could not be fired from U-Boats, and even when used by E-Boats it protruded from the torpedo-tube. It was used extensively during the Normandy Invasion against shipping in the Seine Bay area, and was capable of causing considerable disruption.

Weight: 2220 kg (4894 lb) *Length:* 11 m (36 ft) *Diameter:* 533 mm (21 in) *Speed:* 9 knots *Range:* 57 000 m (62 300 yards)

DAF

Dutch military vehicles. Perhaps better known today for their popular light car, the Van Doorne Automobiel Fabrik NV, of Eindhoven, Netherlands, have a long record of making military vehicles. Most of these have been cargo trucks and prime movers, but the company began armoured vehicle manufacture in the mid-1930s with a six-wheeled armoured car, the Panserwagen 1.

The Panserwagen 1 showed evidence of original thought. There was no conventional chassis, the suspension units being attached directly to the armoured body of the car; the armour surfaces were sloped to deflect shot; the suspension could cope with large terrain irregularities; and an intelligent crew layout allowed all-round protection from two hull machine-guns and a 37-mm (1.4-in) cannon and co-axial machine-gun in a revolving turret. This vehicle appeared in Dutch military service in 1936, and was followed by models 2 and 3, each showing small detail improvements. However, no more than about a dozen had been completed by the outbreak of the Second World War.

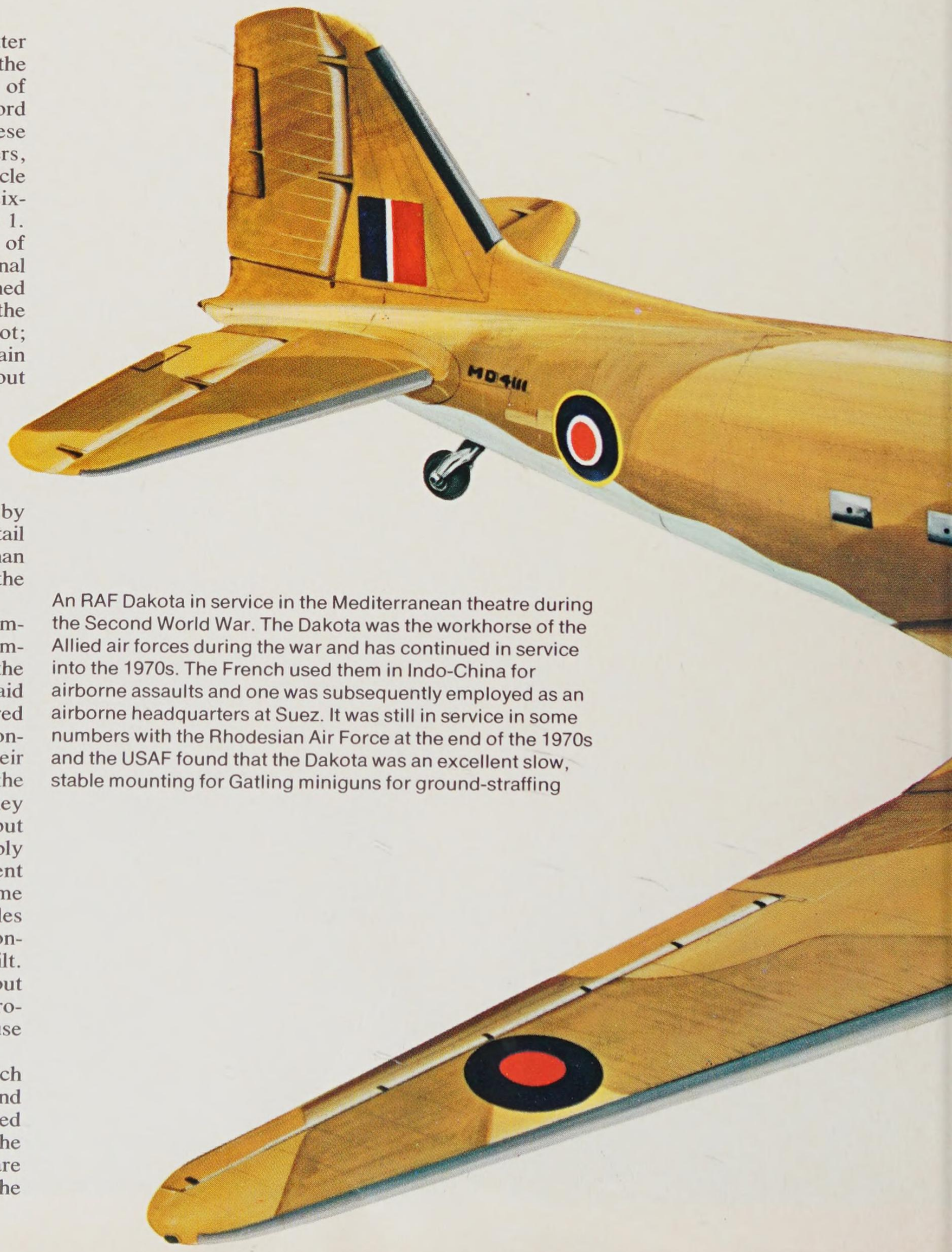
In the immediate postwar years, the company once more concerned itself with commercial vehicles and military trucks, until the mid-1950s when the Netherlands army laid down specifications for a wheeled armoured personnel carrier. Van Doorne won the contract and began development, basing their design on an existing chassis, that of the standard 6×6 military cargo truck which they were then making. A first mock-up was put together in 1957, but it was then considerably redesigned, changing the wheel arrangement to a 6×8 layout. Development took some years and the first of the new YP-408 vehicles did not appear until 1964. Production continued until 1968, a total of 750 being built. During this development period, a light scout vehicle—the YP-104—was taken to prototype stage, but the army did not see a use for it and the project was cancelled.

The YP-408 uses a welded steel hull which can accommodate two crewmen (driver and commander/gunner) and ten fully-equipped infantry soldiers who enter and leave the vehicle by twin rear doors. Firing ports are not provided in the hull sides, so that the passengers cannot fight from the vehicle. The sole armament is a .5-in (12.7-mm) Browning M2(HB) machine-gun in the commander/gunner's hatch. Six of the eight wheels are driven, and the front four wheels are steerable. There is no amphibious capability, though the vehicle can ford to a depth of 1.2 m (3 ft 9¼ in) with minimum preparation.

This standard vehicle is known in the Netherlands army as the PWI-S (Panserwagen Infanterie, Standard). Variant models for special employment comprise the PWI-S(PC) Platoon Commander's vehicle, which contains extra communications equipment; the PWCO Company Commander's vehicle, with more communications equipment and a reduced personnel capacity; the PW-GWT Ambulance, capable of taking two stretcher cases and four sitting casualties, plus medical attendants; the PW-MT which tows the 120-mm (4.7-in) Hotchkiss-Brandt mortar and carries the seven-man mortar detachment and 50 bombs; and the PW-V cargo carrier with a payload of 1500 kg (3307 lb). All these vehicles are solely in use by the Royal Netherlands Army.

(Panserwagen 3 1939) *Weight:* 6000 kg (13 227 lb) *Length:* 4.62 m (15 ft 2 in) *Width:* 2.15 m (7 ft 1 in) *Height:* 2.13 m (7 ft) *Armament:* 1 37-mm (1.46-in); 3 7.92-mm (0.312-in) mg *Powerplant:* Ford V-8 gasolene, 95 bhp *Speed:* 60 km/h (37 mph) *Range:* 300 km (186 miles) *Maximum armour thickness:* 12 mm (0.47 in) *Crew:* 6

(YP-409, PWI-S) *Weight:* 12 000 kg (26 455 lb) *Length:* 6.24 m (20 ft 6 in) *Width:* 2.38 m (7 ft 10 in) *Height:* 1.80 m (5 ft 11 in) *Armament:* 1 0.5-in (12.7-mm) mg; 6 smoke dischargers *Powerplant:* DAF DS575 6-cylinder turbocharged diesel, 165 at 2400 rmp *Speed:* 85 km/h (53 mph) *Range:* 500 km (311 miles) *Maximum armour thickness:* 15 mm (0.59 in) *Crew:* 2 (+10 passengers)



An RAF Dakota in service in the Mediterranean theatre during the Second World War. The Dakota was the workhorse of the Allied air forces during the war and has continued in service into the 1970s. The French used them in Indo-China for airborne assaults and one was subsequently employed as an airborne headquarters at Suez. It was still in service in some numbers with the Rhodesian Air Force at the end of the 1970s and the USAF found that the Dakota was an excellent slow, stable mounting for Gatling miniguns for ground-straffing

Dakota, C-47 (Douglas DC-3)

US transport aircraft. Beyond question the most significant and widely-used transport aircraft in history, the Douglas DC-3 had so many military designations and names that the choice of a consistent designation is almost arbitrary. In fact the first military deliveries were of a type whose designation means little—C-32. These were actually a version of the slightly smaller and less-powerful DC-2, the first commercial model of which flew on May 11, 1934.

Usually powered by two 710-hp Wright R-1820 Cyclone F-series engines, the DC-2 seated 12 or 14 in airline service and 14 was a typical number of equipped troops for military versions. Deliveries of the latter began in 1935 with the US Army Air Corps C-32 and -32A, followed by the R2D-1 of the Navy and Marine Corps. In 1942 civil DC-2s were impressed into Army Air Force service as the C-33. A handful of aircraft formerly operated by European airlines served with the RAF, a few—including the ex-Polish LOT machines—having Bristol Pegasus engines.

First flown on December 17, 1935, the DC-3 introduced a larger fuselage of improved profile carrying 21 passengers, and though it weighed 50% more than a DC-2 the use of 1000-hp Cyclone G-series engines, or Pratt & Whitney R-1830 Twin Wasps, gave increased performance. A key element in this performance was the long-span pointed-tip wing. The first military version, the C-39, was an odd mixture of the new wing mated with the small DC-2 body. Similar aircraft procured in smaller numbers were the C-38 personnel transport with Cyclones and the corresponding C-41 with Twin Wasps.

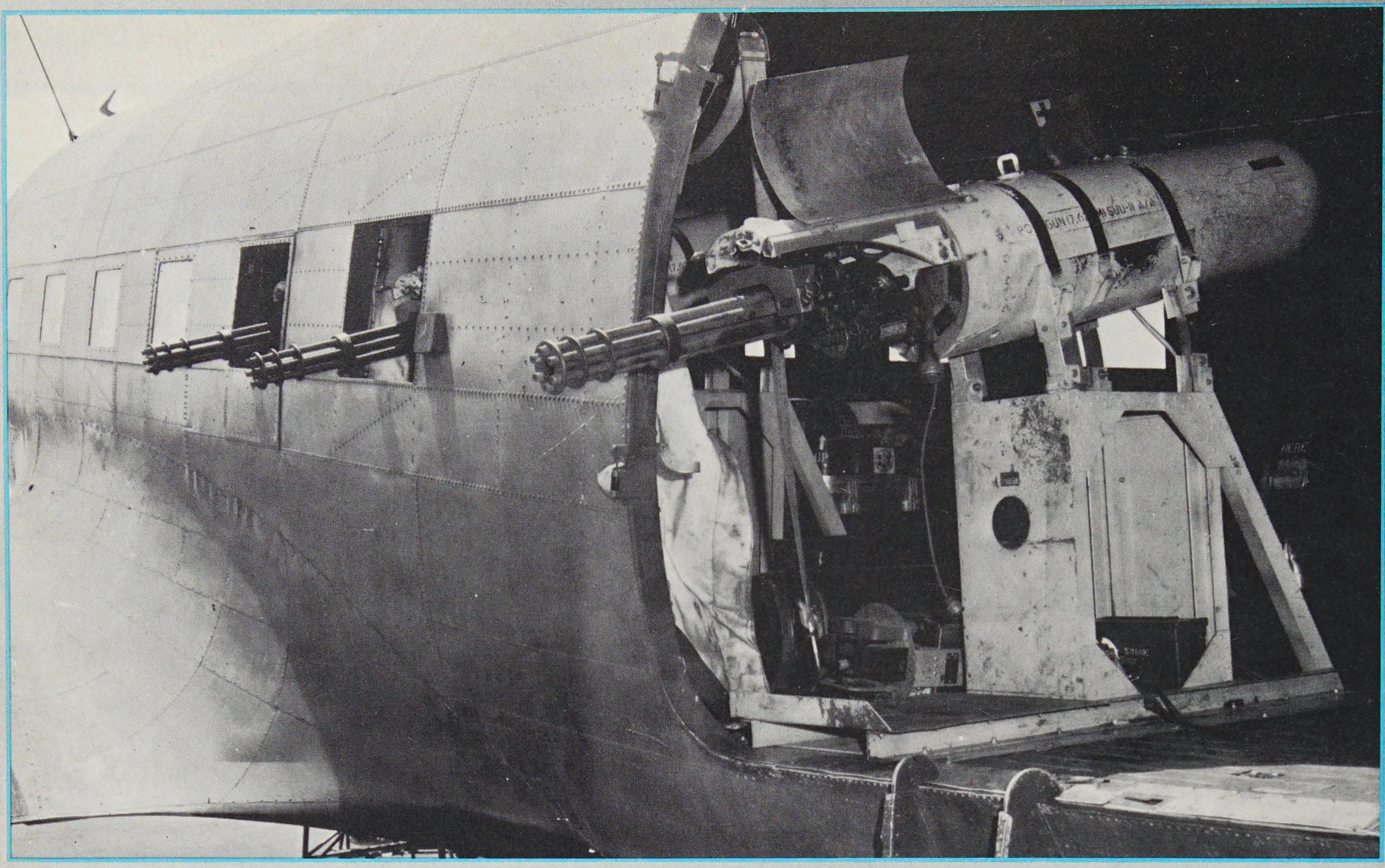
Smithsonian Institution

The single C-47C amphibious floatplane was a 1943 conversion of a C-47A Skytrain intended to increase the type's versatility

Discounting about four civil DC-3s sold as VIP transports to overseas air forces, there was no true military DC-3 until October 1941, when deliveries began from Santa Monica of the C-53 Skytrooper. This simple conversion of the DC-3 had a wooden floor, fixed aluminium seats for 28 troops, and a glider towing cleat. Some were later supplied to the RAF as the Dakota II, and the US Navy and Marines as the R4D-3, and subsequent versions included the C-53B, C and D.

The main military type, put into large-scale production in late 1941 at Santa Monica, Tulsa and Oklahoma City, was the C-47 Skytrain. This had been designed earlier in 1941—hence the earlier type-number—as an all-purpose military transport with strong freight floor, large double doors, tie-down fittings and folding wooden troop seats. The engine chosen was the 1200-hp R-1830-92 Twin Wasp. A first batch of 953 was followed in 1942-43 by 4991 C-47A with 24-volt electrics, and in 1943 by 3108 C-47B for high airfields (especially in India and China) with R-1830-90C engines with two-stage blowers. Named Skytrain by all US forces, and designated R4D by the Navy, some 1200 C-47, 47A and 47B were supplied to the RAF under lend-lease as the Dakota I, III and IV, respectively. Douglas also built 133 TC-47B trainers (R4D-7) with navigation-classroom interiors, and one C-47C twin-float amphibian version.

Other oddballs included the XCG-17 glider converted from a production C-47A, and the unique 'DC-2½' flown out of China in an emergency with one DC-3 wing and one DC-2 wing, the original having been damaged



US Air Force

The 7.62-mm (0.30-in) miniguns mounted in the fuselage of an AC-47 gunship photographed in May 1967 at Nha Trang Air Base, South Vietnam

Dakota

The Douglas C-47 Dakota, which had served throughout the Second World War as the major Allied air transport and participated in all the famous airborne assaults, soldiered on after 1945. The French notably used the C-47 in Indo-China and even employed one as a flying HQ at Suez. When the United States became involved in Vietnam they looked for an aircraft with capacity and endurance which could carry the 7.62-mm minigun, a weapon which operated on the Gatling principle. The C-47, renamed the AC-47D, was not only capable of circling slowly over an area as small as a football pitch, but had the capacity to carry the vast amounts of ammunition consumed by three miniguns. At night the low drone of the engines, interrupted by a louder drone as the guns opened fire, would be a sign that 'Puff the Magic Dragon' was at work. The AC-47D earned this nickname from the constant stream of tracer fire that poured from the fuselage guns, but it had other names too. Its fire was so destructive that nothing survived in a target area, and though some soldiers called it 'Snoopy', it seemed more apt to call this anonymous airborne killer 'Spooky'

McDonnell Douglas

US Air Force

USAAF C-47s line up on the taxiways of a British airfield prior to the invasion of Europe in June 1944. Paratroops spearheaded the D-Day landings

beyond immediate repair. The glider was outstandingly successful, carrying 40 troops, towing at 464 km/h (288 mph) behind a C-54 and landing at only 56 km/h (35 mph), but only one was built.

Wartime impressed civil DC-3s included the C-48 (R-1830) with civil furnishing (some were DST sleeper transports), C-49 (R-1820) usually with cargo floor and astrodome, C-50 (R-1820), C-51 (R-1820) for paratroops, C-52 (R-1830) taken over on the civil production line and completed as paratroop transports, C-68 (R-1830) previously the DC-3A late-1930s civil type, and C-84 (R-1820) previously the DC-3B. In 1945 17 purpose-built VIP transports were delivered, designated C-117A.

Accomplishments of the DC-3 in the Second World War are legion; almost 1000 crossed the Channel on the night of D-Day, June 6, 1944, many towing gliders, while in China a C-47 took off at a high-altitude strip with 75 evacuees on board. Total wartime output by the US (almost all Douglas) was 10 123.

In 1949 Douglas built two prototypes of a much improved Super DC-3, aimed chiefly at the airlines, with 1475-hp R-1820-C9HE engines and greatly-altered airframe. Few were sold, the main customers being the US Navy/Marines (R4D-8) and Air Force (C-117D).

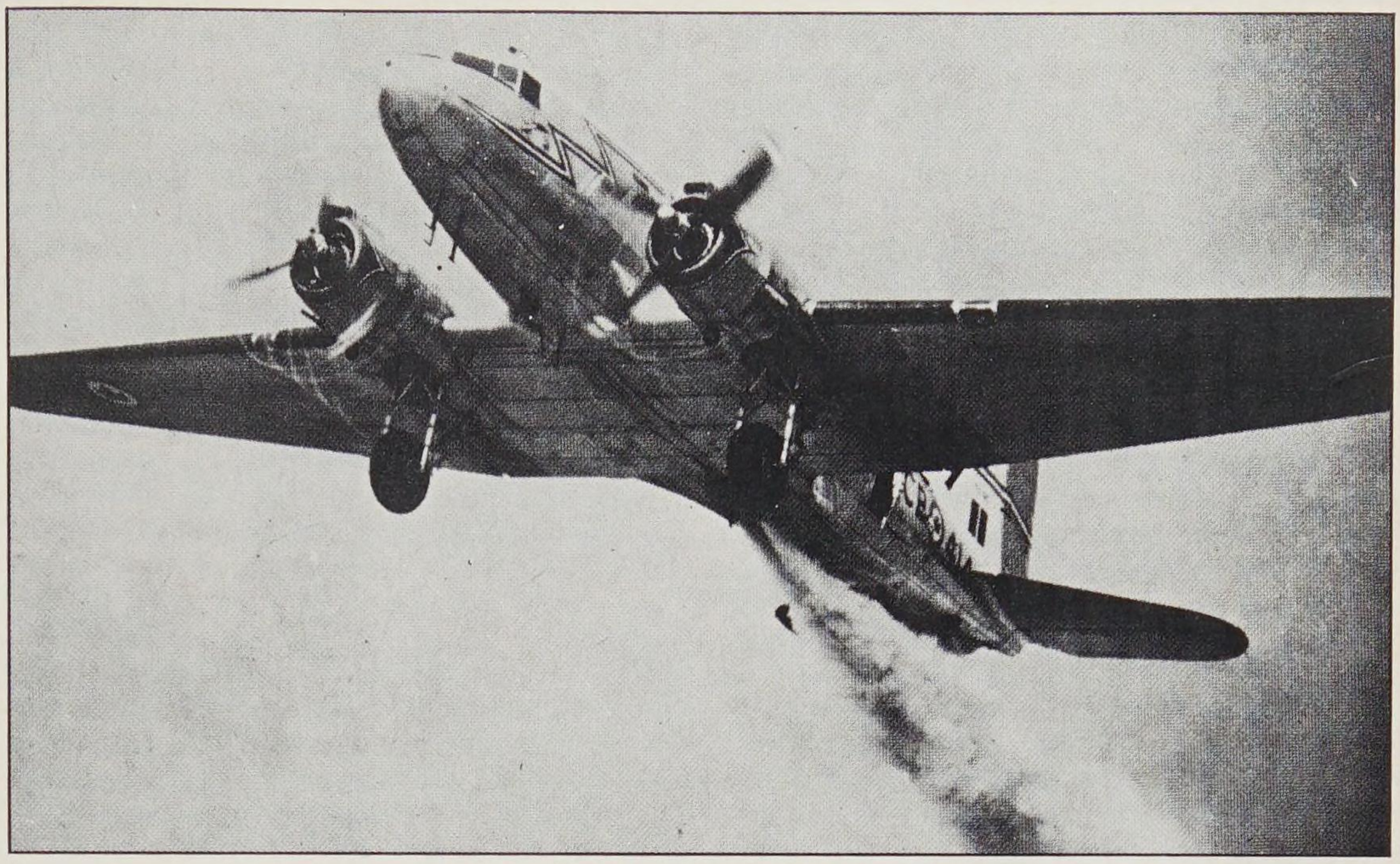
In February 1938 Mitsui in Japan acquired a licence to build the DC-3, on the secret orders of the Japanese navy. During 1939-45 the Japanese companies Showa and Nakajima respectively delivered 416 and 71 of the

L2D-1 to L2D-4 versions, with 1300-hp Kinsei engines and cockpit windows extending much further aft than in the US aircraft. These machines received the Allied code name 'Tabby'.

Much greater licence-production was undertaken in the Soviet Union. Under Boris Lisunov, who had studied the DC-3 at Santa Monica, the Li-2 version—considerably altered, and with entrance on the right—was in full production during 1939-43, about 3500 being built. Most had the M-621R engine, and many had a gun turret behind the flight deck. Postwar Allied reporting name was 'Cab', this also covering the 707 lend-lease C-47A and B which reached the Soviet Union in 1942-43.

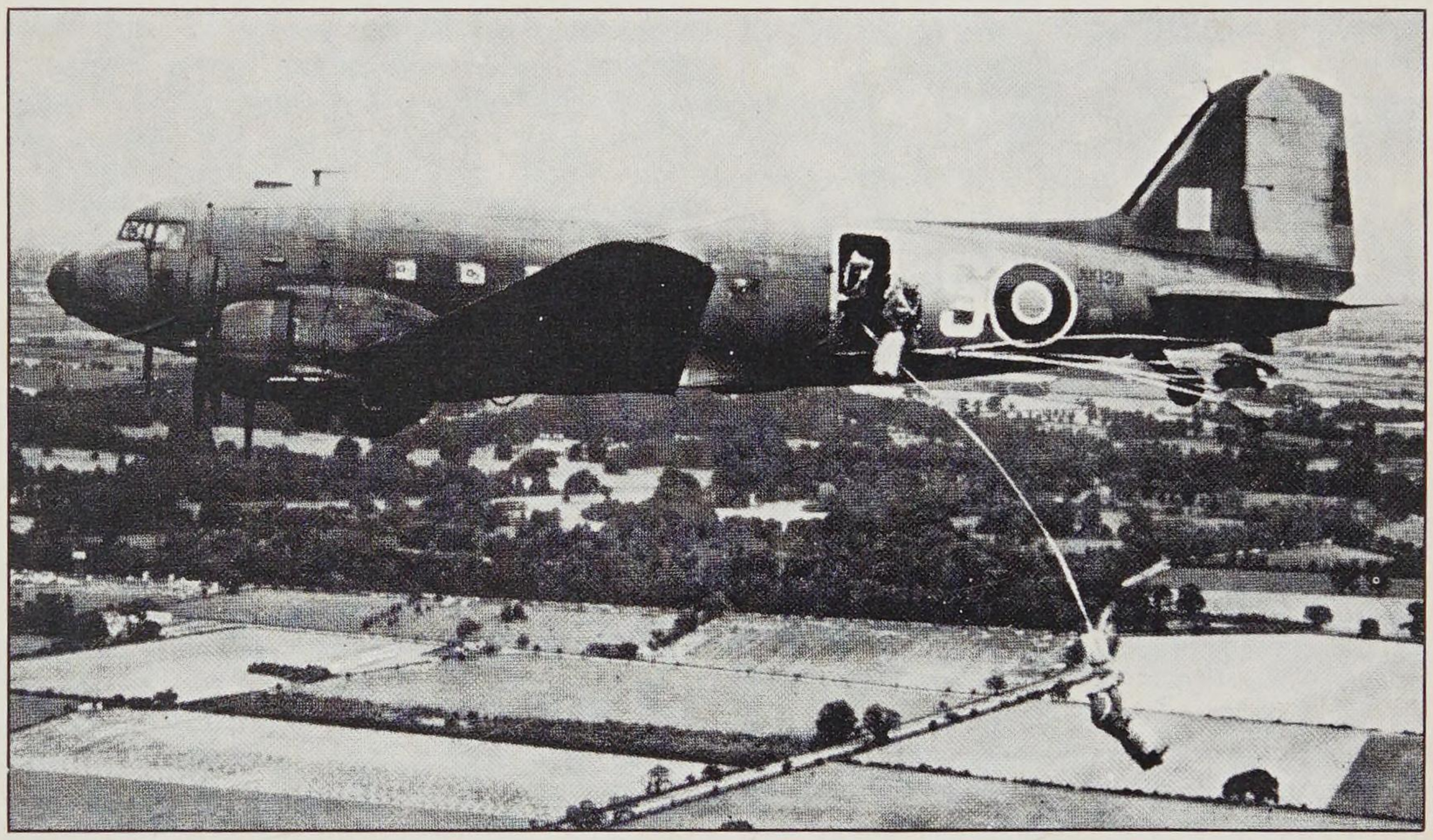
In recent years the military DC-3 has been converted for a multitude of roles. Many have landed at both the North and South Poles, on skis, while other air forces used the F-104G with 'needle noses' for training pilots in the Nasarr radar. Most dramatic of all the conversions has been the various series of AC-47 night interdiction gunships usually armed with three 7.62-mm (0.30-in) General Electric Miniguns with no fewer than 54 000 rounds of ammunition. While the basic aircraft had become familiarly called the 'Gooney Bird'—at least to US personnel—the AC-47 was also known as 'Puff the Magic Dragon' or 'Spooky'. The 25 initial conversions proved so useful in Vietnam that they spurred on the later AC-119 and AC-130 programmes.

(C-47, typical) *Span:* 28.96 m (95 ft) *Length:* 19.64 m (64 ft 5½ in) *Gross weight:* 13 290 kg (29 300 lb) (sometimes 14 080 kg, 31 004 lb) *Maximum speed:* 369 km/h (229 mph)



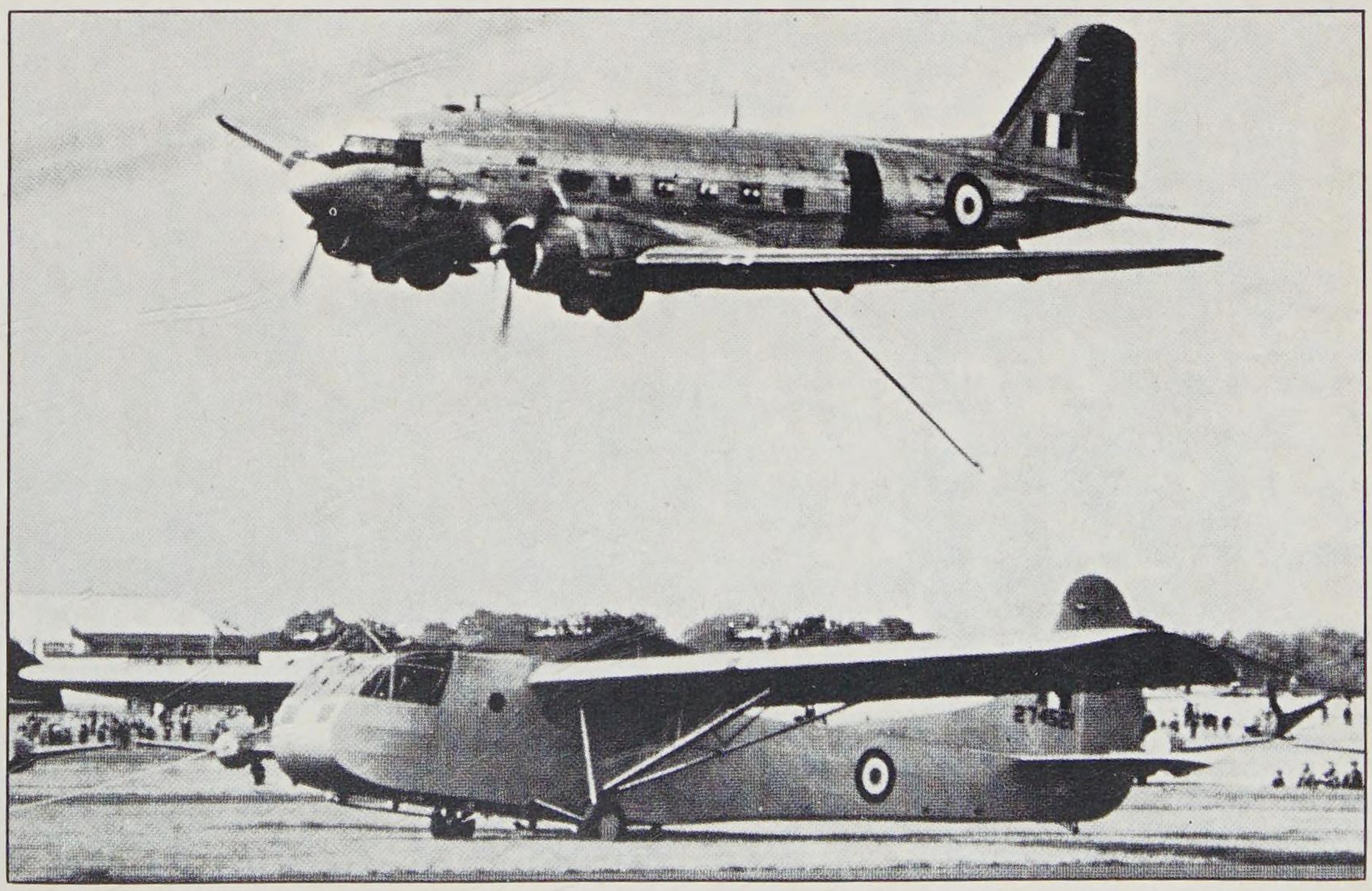
Canadian Armed Forces

Canadian Air Force Dakota Mk III KG414 makes a rocket-assisted takeoff during postwar trials



IWM

Above: **Dakota Mk IV KK138 'S' of No 1 PTS with a stick of paratroops in mid-exit.** ***Below:*** **A Dakota demonstrates a snatch-glide pick-up with a Hadrian glider at Farnborough, 1950**



Flight International

Danae

British cruiser class. Early in 1916 the Admiralty received reports of the construction of large German cruisers armed with 150-mm (5.9-in) guns. As it was thought that these ships would probably outclass the British *Ceres* and similar 'C' Class cruisers, consideration was given to designing a more powerful type. However, at this time it was considered that the optimum size for a 6-in (152-mm) gunned light cruiser had been reached in the 'C' Class and, in order to mount more guns, a reduction in speed would have to be accepted. Having thus agreed to a size limitation, the resulting design produced the *Danae* or 'D' Class cruisers, three of which, *Danae, Dragon* and *Dauntless,* were ordered in September 1916.

They were generally similar to the *Ceres* Class but were 6 m (20 ft) longer and had 0.98 m (3 ft 2½ in) more beam to allow for the addition of a sixth 6-in (152-mm) gun between the funnels and the bridge. The speed was not in fact greatly affected, for although the same machinery power was provided as in the *Ceres* the propeller efficiency was improved by reducing the propeller revolutions from 340 to 275 which gave a design speed of 29 knots at load draught. While under construction it was decided to fit four triple, instead of twin, torpedo tubes giving them the largest torpedo armament of any cruisers in existence.

All three completed in 1918 and the *Danae* and *Dragon,* which joined the 5th Light

Cruiser Squadron with the Harwich Force, were the only vessels of the class to see service in the First World War. *Dragon* and *Dauntless* were completed with an aircraft hangar under the bridge and an aircraft flying-off platform over B gun.

Three more vessels, the *Delhi, Dunedin* and *Durban*, known as the Repeat 'D' Class, were ordered in July 1917. They were much the same as the previous group but adopted the raised trawler bow of the *Carlisle* Class which were ordered at the same time. Length was increased to 144 m (472 ft 6 in) and in order to improve stability (which was being reduced by wartime additions of topweight) the beam was increased to 14.2 m (46 ft 6 in). The first two completed in 1918 while the *Durban* was transferred to Devonport dockyard after the war and completed there in 1921. She differed from her sister ships in having a revolving aircraft platform fitted amidships and 2 4-in (102-mm) (2×1) AA guns in place of the 3-in (76-mm).

Six more Repeat 'D' Class were ordered in March 1918, the *Despatch, Diomede, Daedalus, Daring, Desperate* and *Dryad*, but the latter four were cancelled at the end of the war. The remaining pair were at first suspended and then transferred to Chatham and Portsmouth dockyards respectively where they completed in 1922. Both vessels completed with a revolving aircraft platform and 2 4-in (102-mm) AA guns, as in the *Durban*, and the *Diomede* was also fitted with an enclosed 'weather-proof' Mk XVI mounting for her foremost Mk XII gun instead of the standard Mk XIV open shield mounting. The displacement was about 100 tons greater in these last two ships than in the earlier vessels.

During the 1920s, those ships with 3-in (76-mm) guns had them replaced by 4-in (102-mm) while a third 4-in (102-mm) was added on the after shelter deck of each. In addition the aircraft equipment was removed from those ships in which it had been fitted. Proposals to modernize the class in the later 1930s included the substitution of four twin 4.5-in (114-mm) gun mountings for the 6-in (152-mm) but these plans were cancelled on the outbreak of the Second World War. The *Delhi* was however modernized in the US, under the Lend-lease programme, during 1941-42; her original armament being replaced by 5 5-in (127-mm) (5×1) US type dual-purpose guns, 8 2-pdr pom-poms (2×4) and 8 20-mm (0.79-in) (4×2) AA guns. She was also fitted with a new bridge, tripod masts and US director control. During 1943/44, 6 20-mm (0.79-in) (6×1) were added.

During 1940-41, 8 0.5-in (12.7-mm) (2×4) guns replaced the two single 2-pdr in the bridge wings of *Despatch, Diomede* and *Dunedin*. In 1942-43 the *Danae* and *Dragon* were fitted with a twin 4-in (102-mm) gun in place of the single 4-in (102-mm) guns abreast the fore funnel. The former was also fitted with 8 20-mm (0.79-in) (4×2) and the latter with 6 20-mm (0.79-in) (2×2+2×1) guns while the 6-in (152-mm) gun abaft the bridge and the torpedo tubes were removed from both. At about the same time *Dauntless, Despatch* and *Durban* were fitted with 8 20-mm (0.79-in) (8×1) while 10 20-mm (0.79-in) (2×2, 6×1) were added to, and all the torpedo tubes removed from, the *Diomede*. In 1944 *Danae* had two of her 20-mm (0.79-in) guns replaced by two single 40-mm (1.57-in) Bofors and the *Despatch* was converted to a depot ship having her original armament removed and 10 40-mm (1.57-in) Bofors (10×1) fitted; in 1945 these were increased to 16 40-mm (1.57-in) (16×1) and 10 20-mm (0.79-in) (10×1) guns.

Early war service was generally on foreign stations but during 1942-44 they returned to home waters with the exception of *Delhi* which operated in the Mediterranean until 1945. One of the class was lost, the *Dunedin*, torpedoed by the submarine *U 124* in the South Atlantic on November 24, 1941. The *Dragon* was loaned to the Polish navy from 1943 until 1944, when she and the *Durban* were sunk off Normandy as part of the breakwater for the Mulberry artificial harbour. She was replaced by *Danae* which, under the name *Conrad*, was manned by the Poles until returned in 1946. The *Dauntless* and *Diomede* served as training ships from 1943 until 1945. The surviving vessels were sold for scrap in 1946 and 1948.

Danae, Delhi, Dunedin—built by Armstrongs
Dauntless—built by Palmer
Dragon, Durban—built by Scotts
Despatch—built by Fairfield
Diomede—built by Vickers

Displacement: 4850 tons (standard), 5750 tons (full load) *Length:* 143.56 m (471 ft) *Beam:* 14 m 45 ft 11¼ in) *Draught:* 4.45 m (14 ft 6 in) *Machinery:* 2-shaft geared steam turbines, 40 000 shp=29 knots *Protection:* 76 mm (3 in) sides, 25 mm (1 in) deck *Armament:* 6 6-in (152-mm) (6×1); 2 3-in (76-mm) (2×1); 2 2-pdr (2×1); 12 21-in (53-cm) torpedo tubes (4×3) *Crew:* 410

Dante Alighieri

Italian battleship, built 1909-1913. The *Dante Alighieri* was the first Dreadnought built for the Italian navy, the first battleship with triple turrets, and also the first with secondary guns in twin turrets. Although designed by Tenente Generale del Genio Navale Edoardo Masdea, the ship reflected many of the ideas of General Cuniberti, with the armament disposed in four triple turrets, a very light secondary armament of 76-mm (3-in) and 120-mm (4.7-in) guns, and a good turn of speed (23 knots).

The specifications called for a displacement not greater than 20 000 tons (an increase of more than 40% over the previous *Regina Elena* Class), a scale of protection sufficient to ensure survival against medium-calibre guns—6-in (152-mm) and 8-in (203-mm)—and the maximum number of heavy guns. The triple mounting was actually a British design from the Armstrong works at Pozzuoli, and it was adopted to save weight without sacrificing gunpower.

The layout of machinery was similar to the *Emanuele Filiberto* Class battleships and the *Garibaldi* Class cruisers, with the machinery between the midships 12-in (305-mm) gun positions, but the boilers were divided into two groups between the midships turrets and the forward and after turrets. This was an inconvenient arrangement, with main steam pipes and propeller shafts having to be routed clear of the magazines and shell rooms, but it lessened the risk of a total loss of power from gunfire or a torpedo hit.

Approval to build the ship was given in 1908 and she commissioned early in 1913. In March and April of that year she made a brief cruise of 11 270 km (7003 miles) in the Atlantic, calling at Madeira and Dakar, and later joined the 1st Division of the Second Squadron. When Italy entered the war in May 1915 *Dante Alighieri* was flagship of the 1st Battle Squadron, and remained at Taranto for most of the war with other Italian capital units. She was attached to the Southern Adriatic and

The *Dante Alighieri*, Italy's first Dreadnought and the first battleship with triple turrets

Laid down	launched	completed	builder
6/1909	8/1910	1/1913	Cantiere di Castellamare di Stabia

Ionian Sea Forces from 1917 to 1918, and was based at Brindisi late in 1918. She conducted a brief bombardment of Durazzo (Dubrovnik) in October, but otherwise had an uneventful war career. She moved to Venice on November 9, to cover the occupation of the Dalmatian coast, and was later involved in supporting the Italian occupation of Fiume between May 1919 and January 1921.

After a refit at La Spezia she went into reserve, but recommissioned in 1924. She was given a tripod mast and large control top in place of the pole foremast, and in 1925 she embarked a Type M18 seaplane. In 1913 she had also conducted trials with a Curtiss seaplane, carried on deck amidships, but in both cases it was only a temporary feature. The ship remained in commission for another three years, during which she acted as guardship for the Schneider Trophy races at Venice. She was laid up on July 1, 1928, officially stricken four months later and scrapped.

Displacement: 19552 tonnes (normal), 21600 tonnes (full load) *Length:* 168.15 m (551 ft 8 in) *Beam:* 26.6 m (87 ft 3½ in) *Draught:* 8.86 m (29 ft) *Machinery:* 4-shaft geared steam turbines, 32200 shp=22.8 knots *Protection:* 250 mm (9.8 in) belt, 50-40 mm (1.97-1.57) deck, 280 mm (11 in) conning tower, 250-230 mm (9.8-9 in) main turrets, 230 mm (9 in) secondary turrets, 100 mm (3.9 in) battery *Armament:* 12 12-in (305-mm)/46-cal (4×3); 20 4.7-in (120-mm)/40-cal (4×2 12×1); 16 3-in (76-mm)/40-cal (16×1); 2 2-pdr, 40-mm (1.57-in)/39-cal AA pom-poms (2×1) added 1915; 3 17.7-in (45-cm) torpedo-tubes (submerged, 2 beam 1 stern) *Crew:* 970

Danton

French battleship class, built 1906-1911. This class was built after the Dreadnought revolution was under way, but because of the parlous state of the French navy after the disastrous Pelletan administration of 1902-1903, resources did not allow for the building of anything but an obsolescent design. However, the heavy secondary armament of the *Dantons* entitled them to rank as 'intermediate' Dreadnoughts', and they approximated to the British *King Edward VII* Class in gunpower.

The appearance of the ships reflected the obsolescence of their machinery, with five funnels in two groups, three forward and two aft. The Parsons steam turbine was adopted, but it was found to be very uneconomical, and as the ships had poor coal-capacity they had an endurance of only 6035 km (3750 miles) maximum at their most economical speed—inferior to rivals' capabilities.

All six served in the Mediterranean during the First World War, and were in the 1st Squadron of the Armée Navale in August 1914. The *Vergniaud* left Toulon on August 3 to hunt for the German battlecruiser *Goeben* and to escort troop-convoys from Algeria to France. She also operated in the Adriatic, and helped to sink the Austrian cruiser *Zenta* on August 15.

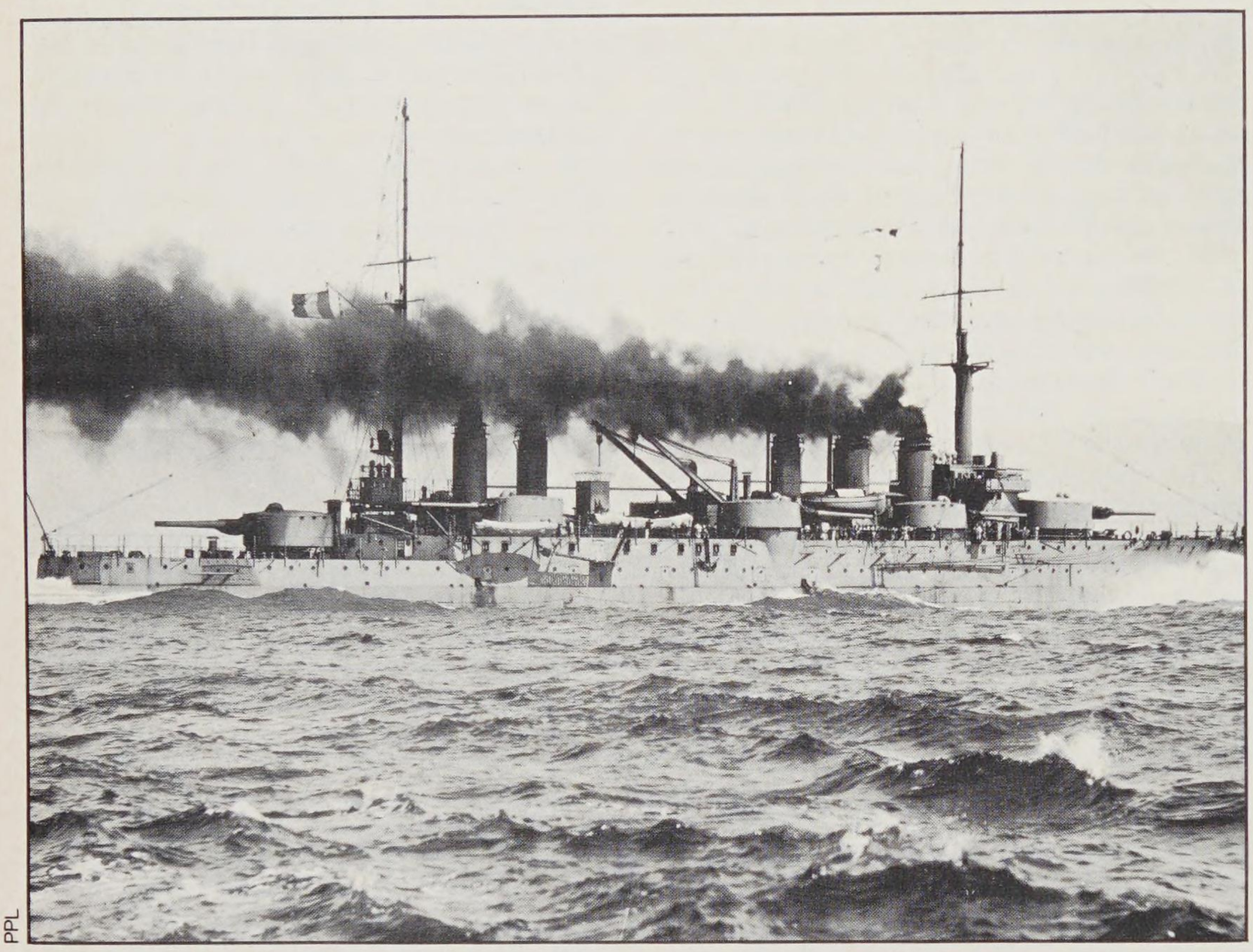
Some indication of the poor quality of French naval guns and gunnery can be gauged by the fact that the five *Dantons* in the action failed to hit the destroyer *Ulan*, even after the range came down from 11800 m (12904 yds) to 4100 m (4484 yds). To make matters worse, defective fuzes caused two 9.4-in (239-mm) guns to burst, and a total of 500 heavy shells were needed to sink the 2200-ton cruiser.

In December 1916 the *Condorcet, Mirabeau, Vergniaud* and *Voltaire* were sent to the Piraeus to overawe the pro-German supporters of King Constantine of Greece, and to support the pro-Allied Venizelos government. After a naval landing party had suffered severe casualties, Vice-Admiral Dartige du Fournet ordered the *Vergniaud* to fire four 12-in (305-mm) shells in the direction of the Royal Palace, whereupon the Allies' demands were conceded.

The six ships (now forming the 2nd Squadron) were sent to Corfu in 1917 to guard against a breakout by the Austrian Fleet, but on March 19, 1917, the *Danton* was torpedoed and sunk by *U 64* West of San Prieto, Sardinia. On the night of October 10, 1918, the *Voltaire* was hit by two torpedoes from

The French battleship *Danton*, dressed overall during a peacetime cruise. She was sunk by *U 64* on March 19, 1917, off San Prieto, Sardinia

Name	laid down	launched	completed	builder
Danton	2/1906	7/1909	3/1911	Brest arsenal
Voltaire	7/1907	1/1909	6/1911	La Seyne, Toulon
Condorcet	8/1907	8/1909	6/1911	Penhoët, St Nazaire
Diderot	10/1907	4/1909	6/1911	La Seyne, Toulon
Mirabeau	5/1908	10/1909	7/1911	Ch Loire, St Nazaire
Vergniaud	7/1908	4/1910	9/1911	Ch Gironde, Bordeaux



PPL

***Voltaire* at speed. This *Danton* Class battleship served in the Mediterranean and Black Sea during the First World War and survived two torpedo attacks by *UB 48* in October 1918**

UB 48 but managed to limp into harbour. She is reputed to have been fitted with antitorpedo 'bulges' in 1917, which would account for her resistance to flooding.

In the spring of 1918, the *Diderot, Mirabeau, Vergniaud* and *Voltaire* were stationed at Mudros to guard against a breakout by the ex-Russian ships recently captured at Sevastopol by German forces. With the *Voltaire* under repair, the remaining three moored off Constantinople on November 13 after the surrender of Turkey and entered the Black Sea to support the Anglo-French intervention in the Russian Civil War. The *Vergniaud* and *Mirabeau* both fought inconclusive actions against Bolshevik surface forces off Sevastopol, but on February 8, 1919, the *Mirabeau* ran aground on the Crimean coast in a blinding snowstorm. She was refloated two months later, but only after the removal of the forward 12-in (305-mm) turret and the side armour. The hulk was towed back to Toulon by the *Justice*, but in 1921 she was condemned as unfit for repair, and laid up.

In spite of their age, the surviving ships lasted a remarkable time. The bare hull of the *Mirabeau* was used for various experiments and finally scrapped in 1928. The *Vergniaud* was surplus to the permitted strength under the terms of the Washington Treaty, and had been damaged in the Crimea, and in 1922 she was used as a target for aircraft. The three survivors formed the Channel Division in 1920-22 and, after refit, they formed the Training Squadron. *Condorcet* became the torpedo school hulk at Toulon in 1931, her sisters were condemned in 1935-36 and scrapped in 1937-39. The *Condorcet* survived in a backwater of Toulon until August 1944, when German forces scuttled her. Although raised by the Allies, she was scrapped in 1945-47.

Displacement: 18 400 tons (normal), 20 000 tons (full load) approx *Length:* 146.6 m (481 ft) oa *Beam:* 25.8 m (84 ft 7¾ in) *Draught:* 9.2 m (30 ft 2¼ in) mean *Machinery:* 4-shaft steam turbines, 22 500 shp=19½ knots *Protection:* 255-204 mm (10-8 in) belt; 75-65 mm (2.95-2.55 in) main deck; 75 mm (2.95 in) lower deck; 320 mm (12.6 in) main turrets; 223 mm (8.8 in) secondary turrets; 300 mm (11.8 in) conning tower *Armament:* 4 12-in (305-mm)/45-cal Model 1906 (2×2); 12 9.4-in (239-mm)/45-cal Model 1902 (6×2); 16 75-mm (2.95-in) Scheider Model 1906 (16×1); 10 47-mm (1.85-in) Model 1902 (10×1), removed after First World War; 2 45-cm (17.7-in) torpedo-tubes (submerged, beam) *Crew:* 926

Dantorp Danish export model of British Hawker Horsley torpedo bomber See **Horsley**

Daphné

French submarine class, built 1958-70. Ten of an improved *Arethuse* Class were ordered as Q 241-254 between 1958 and 1965, conventional hunter-killer submersibles with a diving depth of 300 m (984 ft). Although the class has not been without its problems, two having been lost in diving accidents, the French Government's policy of selling to all comers has made the *Daphné* design as successful an export item as the contemporary British *Oberon* design. Three were built for South Africa, three for Pakistan, four for Portugal and four were built for Spain in Spanish yards.

French *Daphné* Class

No and name	launched	builder
S.641 *Daphné*	6/1959	Dubigeon, Nantes
S.642 *Diane*	10/1960	Dubigeon, Nantes
S.643 *Doris*	5/1960	Cherbourg arsenal
S.644 *Eurydice*	6/1962	Cherbourg arsenal
S.645 *Flore*	12/1960	Cherbourg arsenal
S.646 *Galatée*	9/1961	Cherbourg arsenal
S.647 *Minerve*	5/1961	Dubigeon, Nantes
S.648 *Junon*	5/1964	Cherbourg arsenal
S.649 *Vénus*	9/1964	Cherbourg arsenal
S.650 *Psyche*	7/1969	Brest arsenal
S.651 *Sirène*	7/1969	Brest arsenal

An unusual feature of the *Daphné* design is the heavy torpedo-salvo. Eight 55-cm (21.6-in) tubes are mounted forward and four aft, two in the stern casing, and two angled out midway between the conning tower fin and the stern. These are provided with wire-guidance but, apparently, no reload torpedoes are carried.

Three South African *Daphné* Class (ordered 1967):

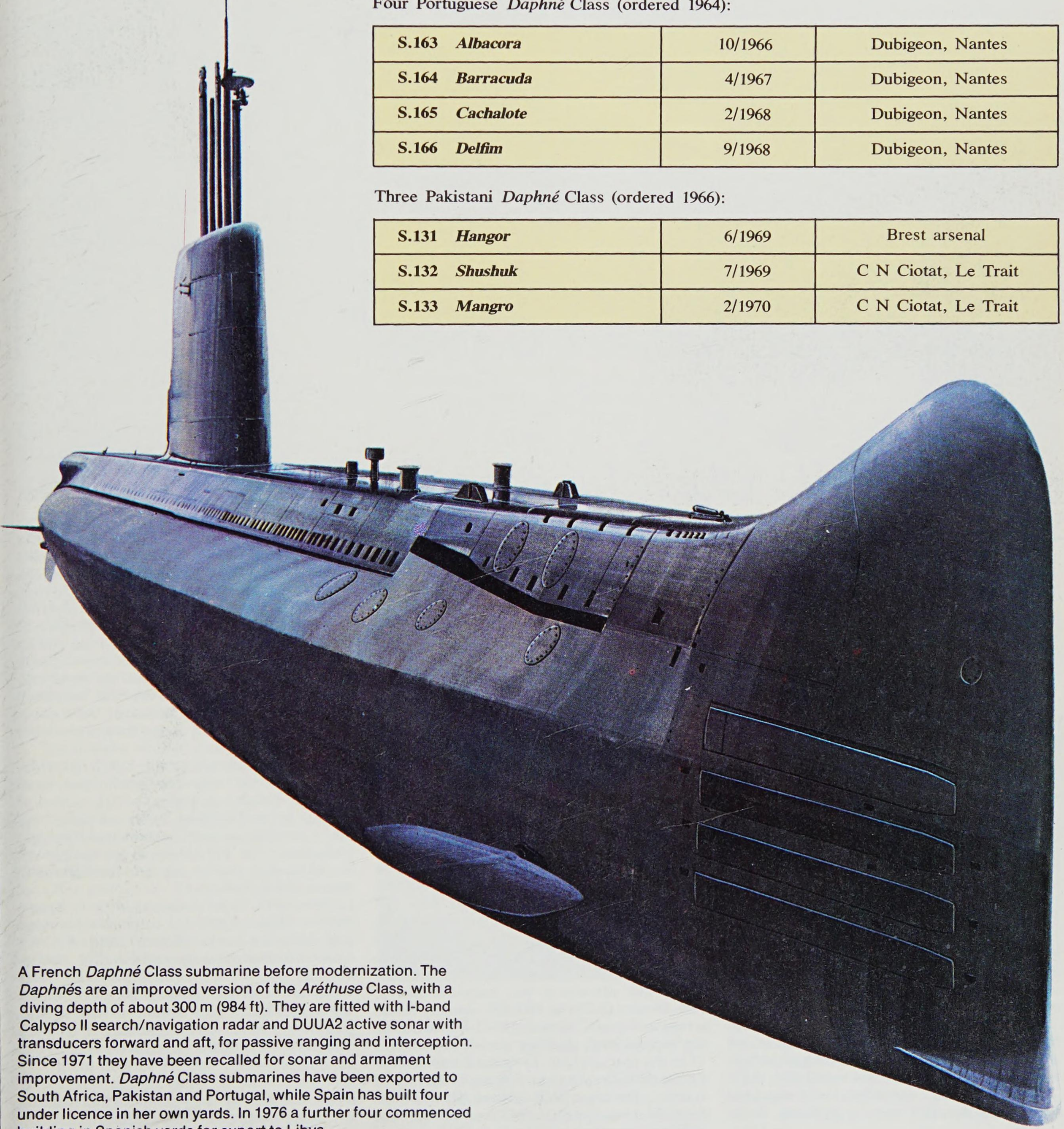
No and name	launched	builder
S.97 *Maria van Riebeeck*	3/1969	Dubigeon, Nantes
S.98 *Emily Hobhouse*	10/1969	Dubigeon, Nantes
S.99 *Johanna van der Merwe*	7/1970	Dubigeon, Nantes

Four Portuguese *Daphné* Class (ordered 1964):

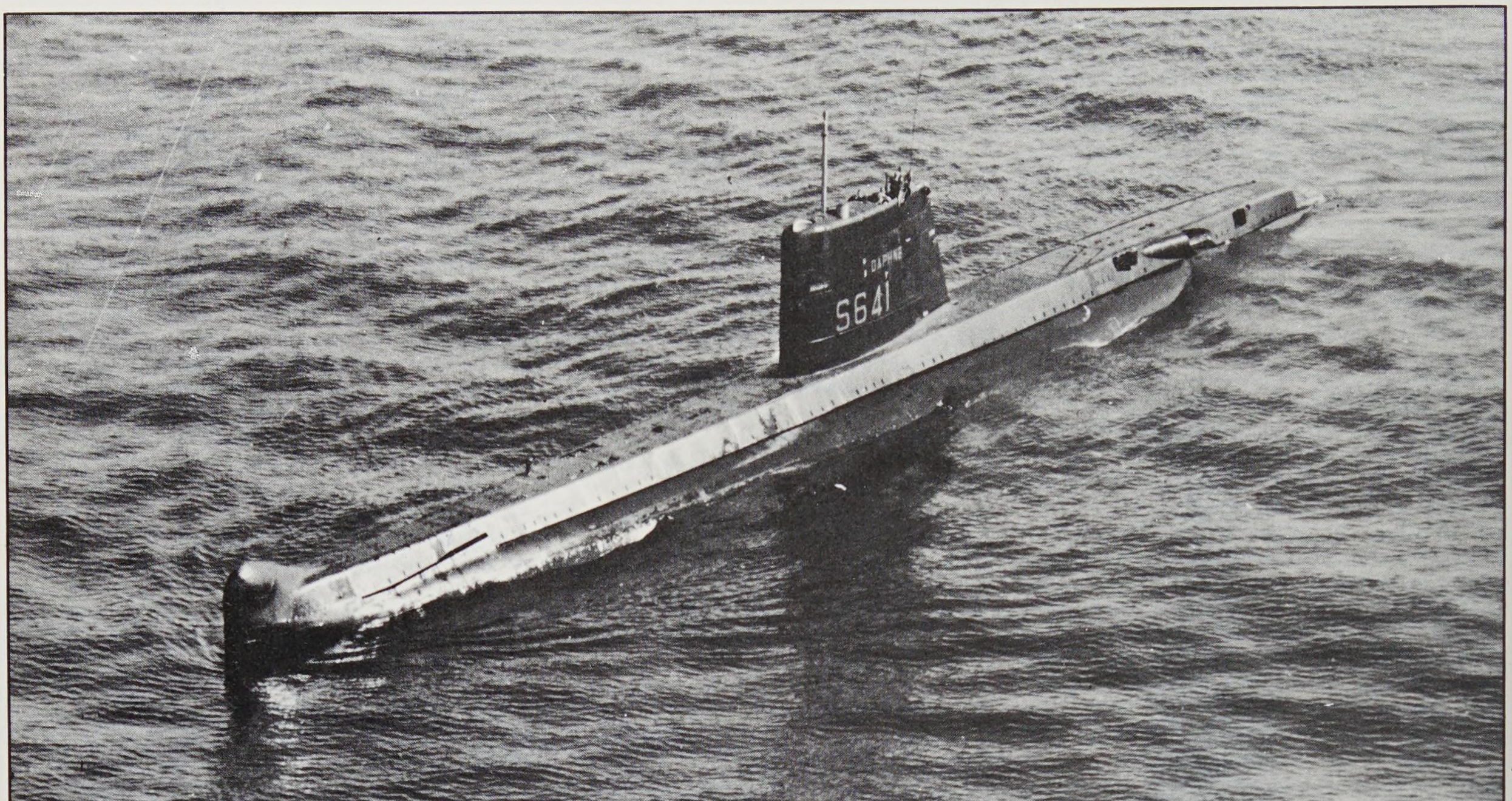
S.163 *Albacora*	10/1966	Dubigeon, Nantes
S.164 *Barracuda*	4/1967	Dubigeon, Nantes
S.165 *Cachalote*	2/1968	Dubigeon, Nantes
S.166 *Delfim*	9/1968	Dubigeon, Nantes

Three Pakistani *Daphné* Class (ordered 1966):

S.131 *Hangor*	6/1969	Brest arsenal
S.132 *Shushuk*	7/1969	C N Ciotat, Le Trait
S.133 *Mangro*	2/1970	C N Ciotat, Le Trait



A French *Daphné* Class submarine before modernization. The *Daphnés* are an improved version of the *Aréthuse* Class, with a diving depth of about 300 m (984 ft). They are fitted with I-band Calypso II search/navigation radar and DUUA2 active sonar with transducers forward and aft, for passive ranging and interception. Since 1971 they have been recalled for sonar and armament improvement. *Daphné* Class submarines have been exported to South Africa, Pakistan and Portugal, while Spain has built four under licence in her own yards. In 1976 a further four commenced building in Spanish yards for export to Libya



Daphné, **the first of a class of French submarines, was laid down in March 1958, launched on June 20, 1959, and commissioned on June 1, 1964. She was followed by ten more vessels but three were lost in accidents, the *Minerve* and *Eurydice* were lost at sea and the *Sirène* at Derman, Lorient**

Four Spanish *Daphné* Class (ordered 1965):

No and name	launched	builder
S.61 *Delfin*	3/1972	E N Bazan, Cartagena
S.62 *Tonina*	10/1972	E N Bazan, Cartagena
S.63 *Marsopa*	3/1974	E N Bazan, Cartagena
S.64 *Narval*	12/1974	E N Bazan, Cartagena

The first of the class, the *Daphné*, was commissioned in June 1964, and the last of the French boats, the *Sirène* in March 1970. The *Minerve* was lost by accident in the Western Mediterranean on January 27, 1968, followed by the *Eurydice* in the same area on March 4, 1970. The *Sirène* sank at Derman, Lorient, on October 11, 1972, after flooding through a faulty torpedo tube. She was raised 11 days later and refitted for further service. Another accident was reported to have happened to one of the South African boats during trials, but there has been no confirmation. The Pakistani *Hangor* sank the Indian frigate *Kukri* on December 9, 1971, during the Indo-Pakistan war. By early 1978 it was believed that the Portuguese *Cachalote* had been bought by the Pakistani navy, but her new name and pendant number had not been revealed.

Since 1971, the eight French boats have been undergoing modernization of sonar and fire-control, but the only external indication is a new, prominent sonar dome. CIT-Alcatel L5 Mod 3 torpedoes were expected to replace the E14 pattern believed to be carried.

Displacement: 869 tonnes/1043 tonnes (surfaced/submerged) *Length:* 57.5 m (188 ft 7¾ in) oa *Beam:* 6.76 m (22 ft 2 in) *Draught:* 4.62 m (15 ft 1¾ in) *Machinery:* 2-shaft diesel-electric, 1300/1600 hp=13½/16 knots (surfaced/submerged) *Armament:* 12 55-cm (21.6-in) torpedo-tubes (8 forward 2 aft, 12 torpedoes carried) *Crew:* 45

DAR-10F

Bulgarian attack bomber. The DAR-10F was the only Bulgarian-designed military aircraft to have seen service. It was a trim but conservative light bomber with an 840/960-hp Fiat A74RC38 radial, and with spatted wheels and a crew of two under a glasshouse canopy.

The gun armament was curiously heavy: two 20-mm (0.79-in) MG FF cannon in the wings and two 7.92-mm (0.312-in) MG 17 in the top decking, all firing ahead, and an MG 15 in the rear cockpit. In spite of this the 10F could still carry up to 500 kg (1102 lb) of bombs. Darjavna Aeroplanna Rabotilnitza flew the prototype in 1941 and a small but unknown number entered Bulgarian service.

Span: 12.65 m (41 ft 6 in) *Length:* 9.83 m (32 ft 3 in) *Gross weight:* 3420 kg (7540 lb) *Maximum speed:* 454 km/h (282 mph)

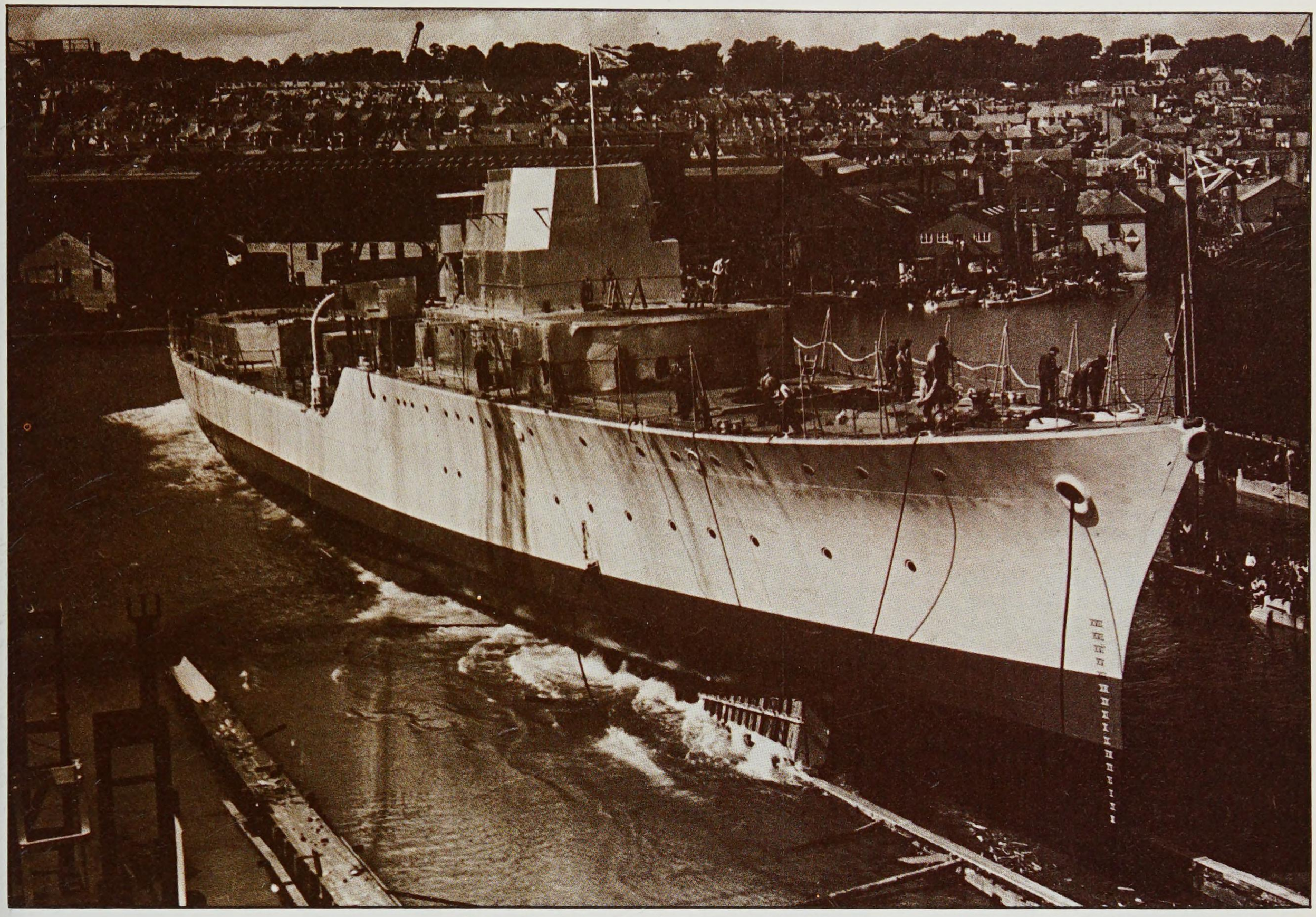
Dardo, S.A.I.403

Italian fighter aircraft. The culmination of a series of remarkable lightweight single-seat fighters by Societa Aeronautica Italiana (Ambrosini), the Type 403 Dardo (Arrow) was one of the most cost-effective warplanes in history. However, it had the misfortune to mature in late 1942, by which time Italian morale had slumped. Output in any numbers appeared impossible, and in the final two years of the programme all that happened was that the first few items of production tooling appeared on a dozen shop floors—but no Dardos.

Earlier designs led to the S.A.I.207, from which the 403 was developed, and from which it differed in having a later series of 750-hp Isotta-Fraschini Delta inverted-V-12 aircooled engine, and constant-speed Piaggio propeller. The airframe was of similar all-wood form to that of the 207, but differed in shape and tailwheel.

The armament comprised two 20-mm (0.79-in) Mauser MG 151 cannon in the wings and two 12.7-mm (0.5-in) Breda-SAFAT heavy machine-guns above the engine. Dardo-C was to be a long-range version with increased internal fuel and two drop tanks. An order for 3000 was placed with S.A.I., Savoia-Marchetti and Caproni, but only the prototype flew as the Armistice put an end to all further work.

Span: 9.8 m (32 ft 1¾ in) *Length:* 8.2 m (26 ft 10¾ in) *Gross weight:* 2640 kg (5820 lb) *Maximum speed:* 648 km/h (403 mph)



COI

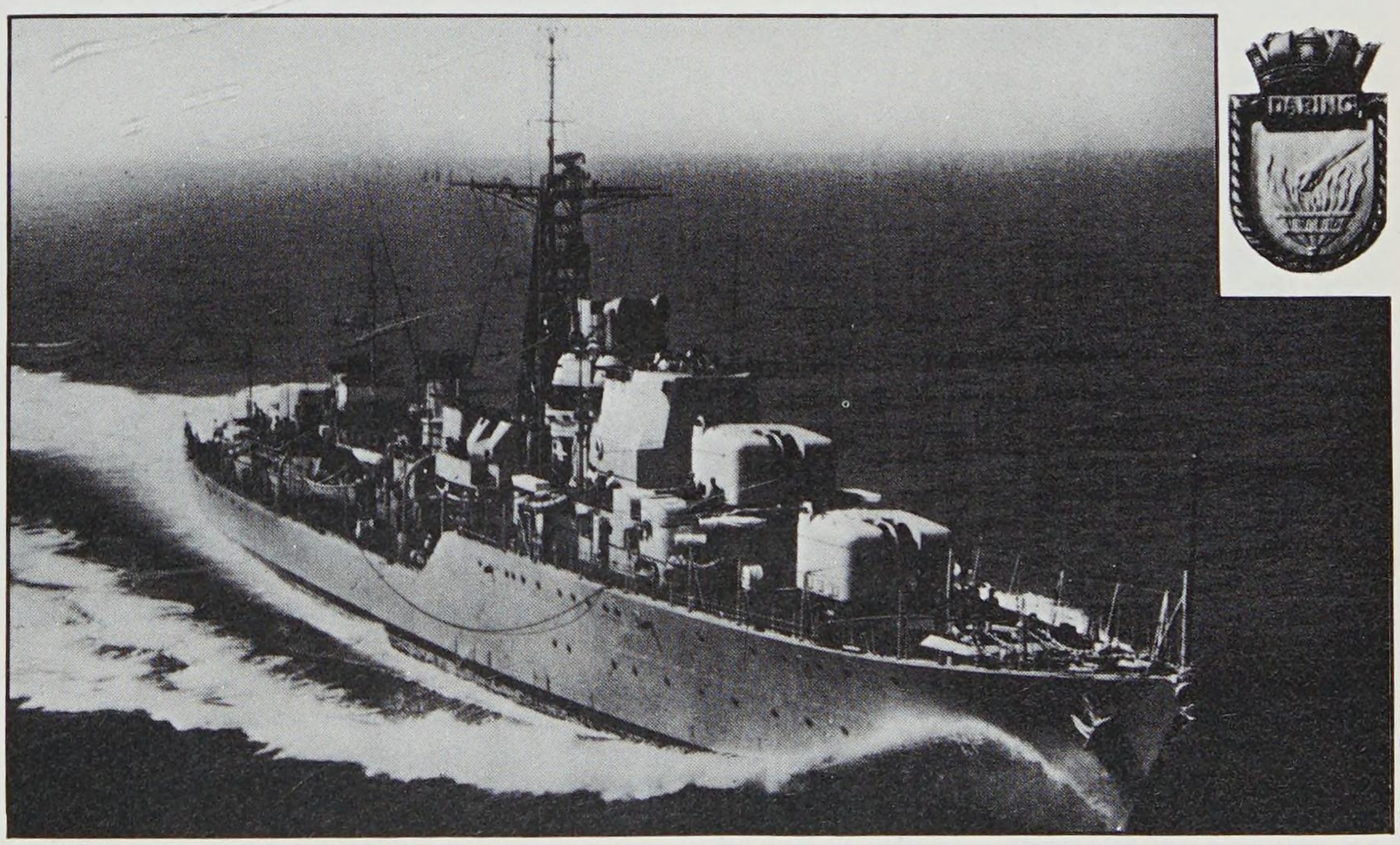
Above: **When launched on August 16, 1950, at Cowes, HMS *Dainty* was the most modern vessel in the Royal Navy. *Below:* HMS *Daring* which, along with *Dainty, Defender, Diana* and *Duchess,* was in the Suez Task Force in 1956. *Inset: Daring*'s name plate**

Daring

British destroyer class. The *Daring*s were the last and largest conventional British fleet destroyers. The design was evolved during 1943-44 and is a typical example of wartime requirements, leading to a substantial increase in size which in peacetime would have been financially unacceptable. This increase in size was largely due to the need to find space for the latest radar and communication equipment, together with a complex multi-function armament.

Their duties were to include attack on, and defence from, enemy destroyers and light craft, antisubmarine and antiaircraft defence and shore support. Because of their size they also went 'scouting', a function normally performed by cruisers. The main armament was fitted in three twin Mk VI mountings, two forward and one aft, with a fully-enclosed box-like gun house. These were dual purpose weapons with a rate of fire of 18 rounds per minute and fully automatic radar control from a Mk VI director mounted on the bridge. The close-range armament was to have consisted of three twin 40-mm (1.57-in) STAAG mountings fitted one each side of the bridge and one abaft the second funnel but prior to completion the latter was replaced by a twin Mk V 40-mm (1.57-in) mounting.

A great deal of attention was given to the machinery design, with a view to saving weight by the adoption of higher steam pressures and double reduction gearing. A unit machinery arrangement was employed with alternate engine and boiler rooms which necessitated two funnels, the foremost of which was led up through the centre of the lattice foremast.



Gale & Polden

Sixteen *Daring*s were ordered during 1944-45 but in December 1945 eight were cancelled. Of the remainder, five were laid down during 1945-46 and three during 1948-49. Construction proceeded at a slow pace and they eventually entered service between 1952 and 1954. In 1946 a further four were ordered by Australia and laid down in that country in 1949-52. One was subsequently cancelled and the remaining three, *Vampire, Voyager* and *Vendetta*, were completed during 1957-59.

Darne

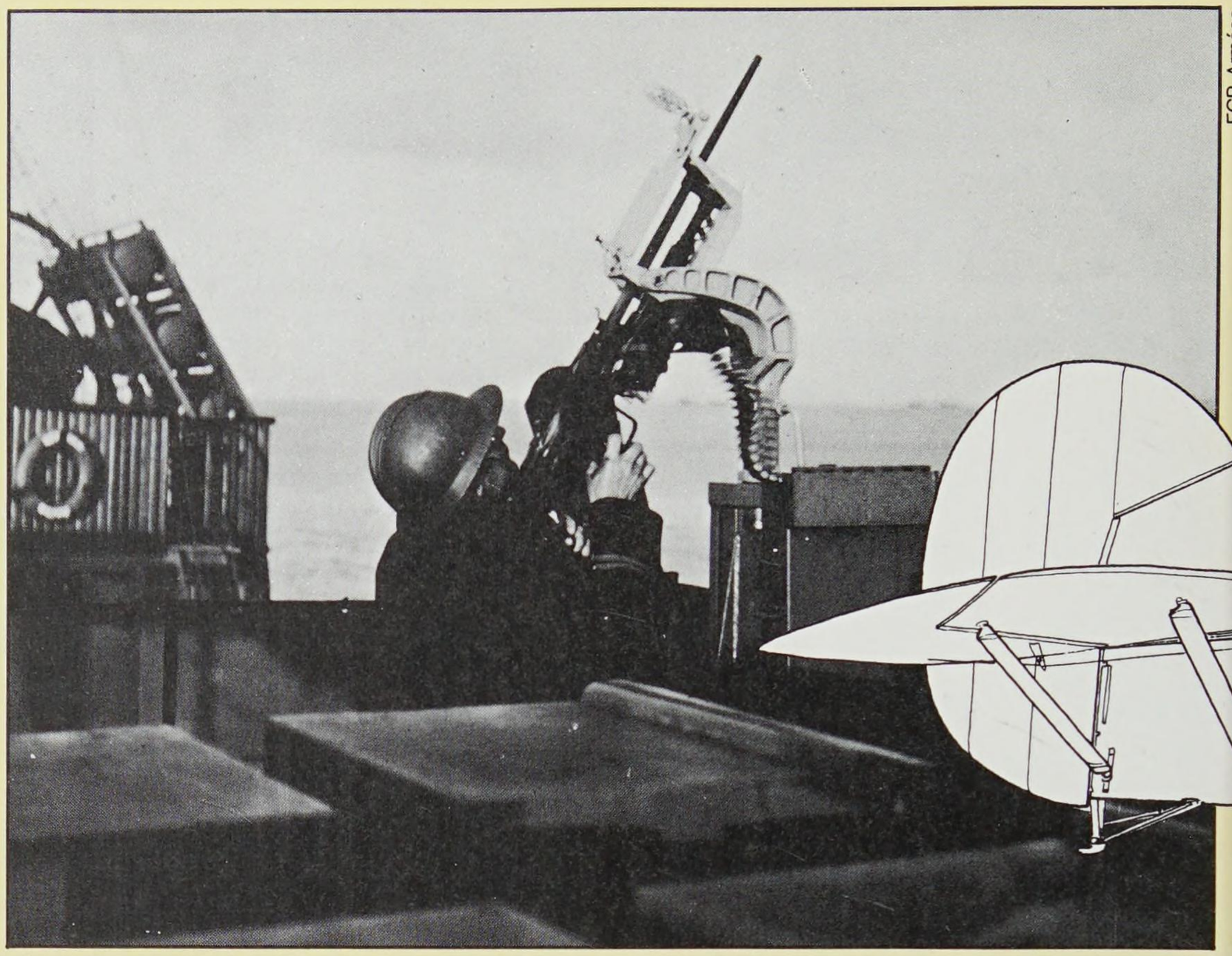
When completed the class was at first classified as *Daring* Type ships, but later reverted to the term destroyer. They were considered ugly, and to improve their appearance the cylindrical second funnel of the *Diana* and *Daring* was fitted with a streamlined aluminium casing, although this was removed in 1957 because it was judged to be a luxury. During 1958-60 preparations were made to fit the class with 'Seacat' GWS and all had the after bank of torpedo tubes replaced by a deckhouse, on which to mount the launcher, and a new director fitted on the bridge. However, only *Decoy* was fitted with this weapon which necessitated the removal of the twin 40-mm (1.57-in) mounting abaft the funnel. She also had her 40-mm (1.57-in) STAAG mountings replaced by single 40-mm (1.57-in) Bofors, a modification extended to the *Diamond, Diana* and *Duchess* during 1961-62. The remaining RN ships had their STAAGs replaced by twin 40-mm (1.57-in) Mk V mountings and their remaining torpedo tubes replaced by another deckhouse during 1963-64.

The three Australian ships, *Vampire, Voyager* and *Vendetta,* were completed with a deckhouse in place of the afterbank of torpedo tubes, and a Limbo antisubmarine mortar in place of the Squid. The *Voyager* was otherwise generally similar to the RN ships except that she mounted Mk V twins in the bridge wings from completion. The other pair mounted these latter weapons abreast the after shelter deck, carried single 40-mm (1.57-in) guns in the bridge wings and had a barrage director both before and abaft the funnel, instead of one on the after shelter deck as in the other ships.

The *Diamond, Defender, Daring, Diana* and *Duchess* were part of the Suez Task Force in 1956. The *Voyager* was sunk in collision with the aircraft carrier *Melbourne* during exercises on February 10, 1964. The *Duchess,* loaned to the Australians as a replacement, was purchased by them in 1971 and converted into a training ship in 1973, having her after 4.5-in (114.3-mm) turret and Squid removed. The *Vendetta* and *Vampire* were refitted during 1970-73 with a modified enclosed bridge, new masts and funnels and updated radar gear, B turret being removed from the *Vampire.* Most of the RN vessels were sold for scrap during 1968-72 but *Decoy* and *Diana* were sold to Peru and renamed *Ferre* and *Palacios.* These two and the Australian vessels were still in service with their respective navies in late 1977.

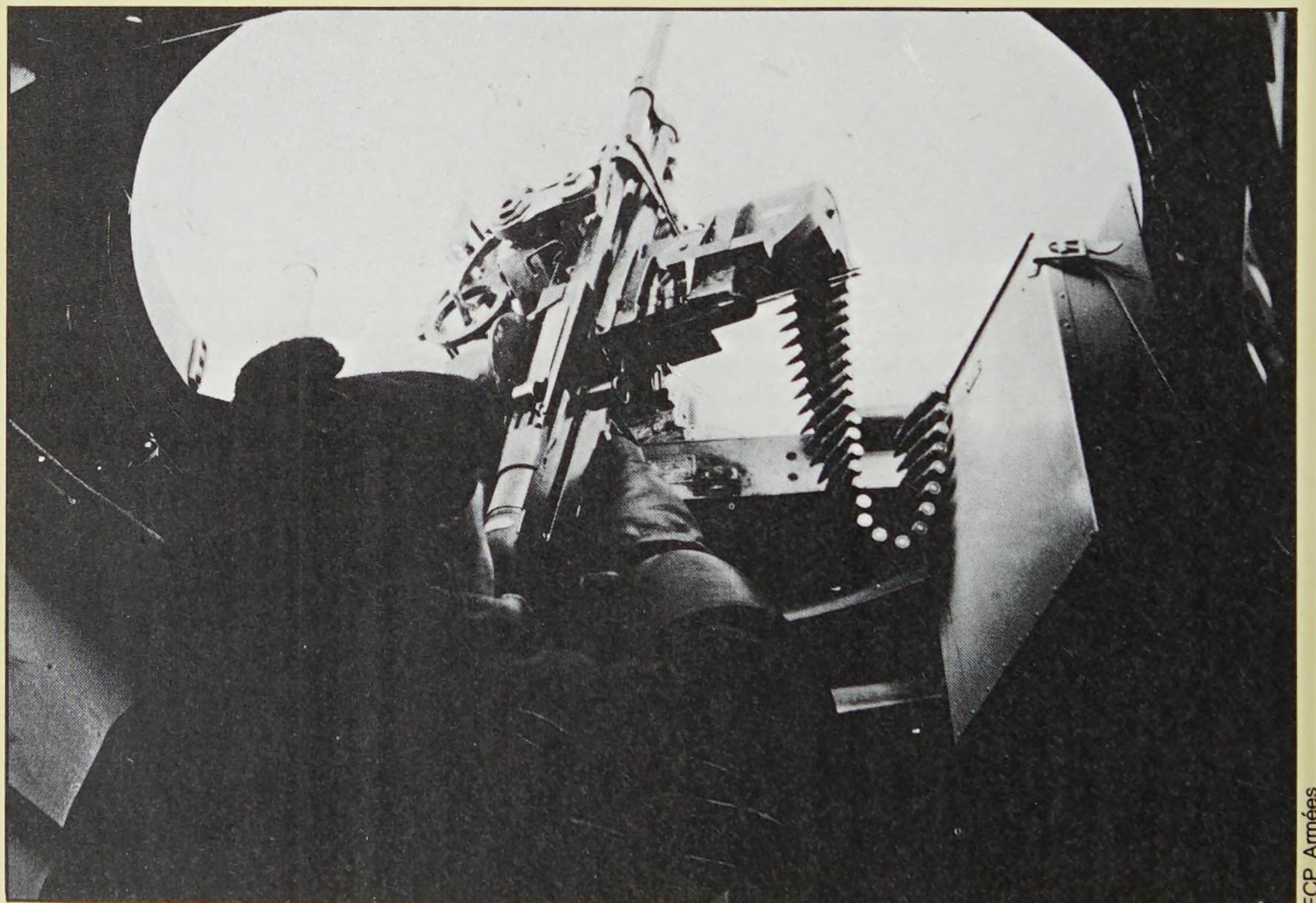
Dainty—built by White
Daring—built by Swan Hunter
Diamond—built by John Brown
Delight—built by Fairfield
Defender—built by Stephen
Decoy, Diana—built by Yarrow
Duchess—built by Thornycroft
Vampire, Voyager—built by Cockatoo dockyard
Vendetta—built by Williamstown dockyard

Displacement: 2950 tons (standard) 3580 tons (full load) *Length:* 118 m (387 ft) *Beam:* 13 m (42 ft 8 in) *Draught:* 3.9 m (12 ft 9 in) *Machinery:* 2-shaft geared steam turbines, 54 000 shp = 34 knots *Armament:* 6 4.5-in (114-mm) (3×2); 6 40-mm (1.57-in) (3×2); 10 21-in (53-cm) torpedo tubes (2×5); 1 Squid A/S mortar (1×3) *Crew:* 290



ECP Armées

Above: **A sailor fires a Darne 7.5-mm machine-gun on the *Newhaven* during landings in Norway**



ECP Armées

Above: **A Darne machine-gun in a high angle mounting on a French seaplane in February 1940**

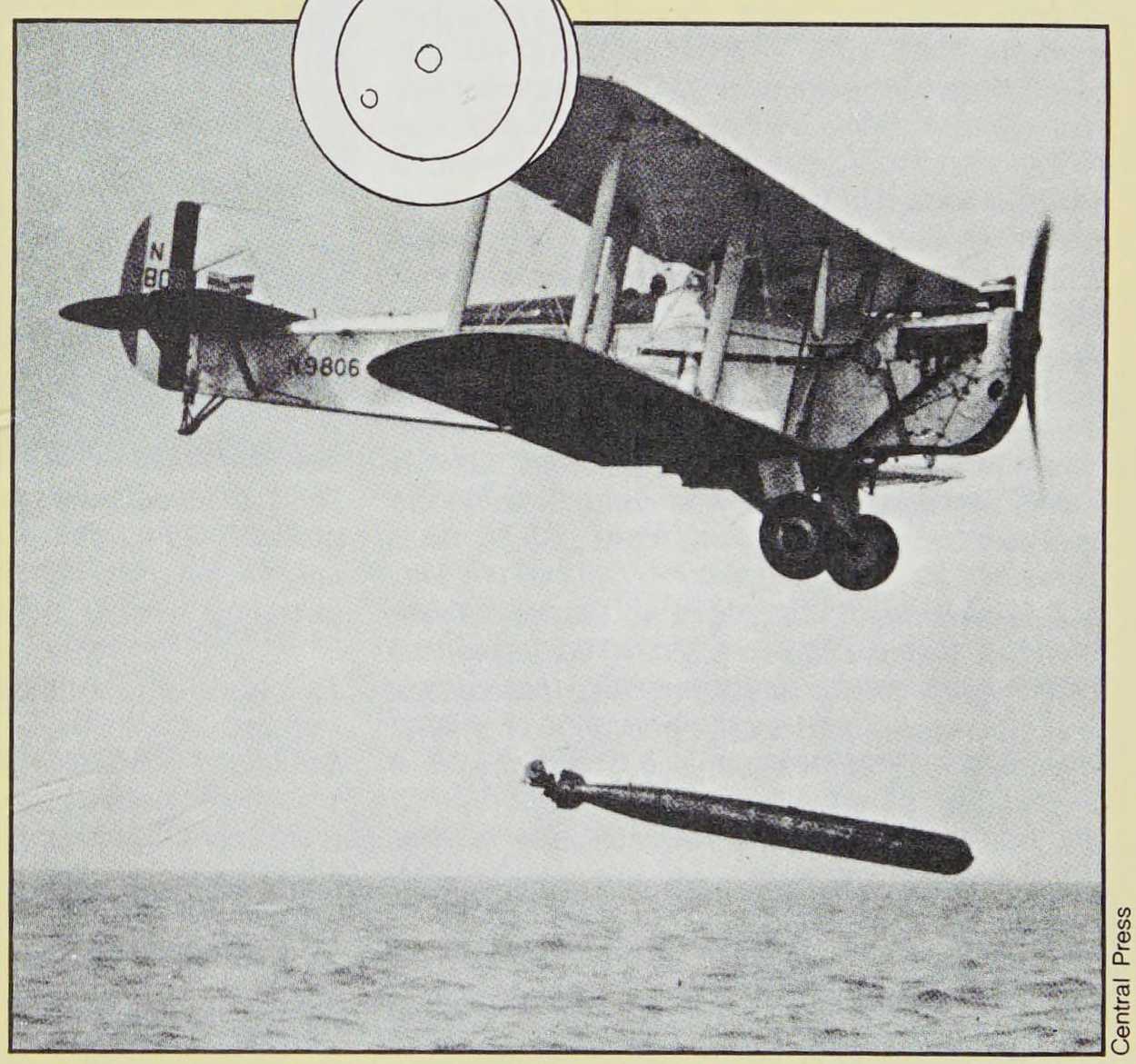
Darne

French machine-gun. The French company of Regis & Pierre Darne, of St Etienne, came to prominence in the 1890s with their development of an unusual shotgun in which the breech slid rearward, away from the fixed barrels, by the action of an operating lever. These shotguns, made to an extremely high standard, were still being made in 1978, and are renowned as one of the finest European guns.

During the First World War the company was given a contract to manufacture Lewis machine-guns, and this seems to have stimulated their interest in this type of firearm. In the years after the war they began to develop a design of their own, and eventually produced a gas-operated gun which was widely adopted in Europe as an aircraft machine-gun. Two versions were produced, a 'free' gun for observers and a fixed gun for installation in fighter aircraft. Both were tested by the Royal Air Force in 1934, but were turned down in favour of other designs.

While the Darne guns had a high rate of fire —1700 rds/min, very desirable for aircraft work—their prime failing in many people's

The Blackburn Dart carrier-borne torpedo-bomber was the first aircraft of this type to be developed after the First World War; it served aboard the *Furious*, *Eagle* and *Courageous* between 1923 and 1929



ECP Armées

Central Press

A Darne machine-gun installed in a Vought V-156 Vindicator in 1939 **A Blackburn Dart of the Torpedo Training Flight releases a torpedo**

eyes was that they were cheaply made. There were no forged parts, everything being either of stamped metal or made on a lathe, which resulted in the finished guns selling for as little as $28 in 1930. The contrast between this and the exquisite and expensive shotguns is remarkable, and it has been suggested that the Darne company's philosophy was that the aircraft which carried the gun were unlikely to survive many missions, so there was little point in building an expensive gun to go inside them.

The company also produced a handful of prototype infantry machine-guns as well as an 11-mm (0.43-in) antitank cannon, but none of these designs were ever put into production. The machine-gun side of the business lapsed in 1940 and has never been revived.

Dart, Blackburn

British carrier-borne torpedo-bomber. The Dart was the first postwar British production aircraft of its type, and was developed from the 1919 Blackburn Swift prototype, purchased by the Air Ministry in January 1921.

After three prototype Darts, orders followed between 1923-26 for a total of 114 production examples, the final 10 having a convertible wheel/float landing gear. The remainder had a wheels-only gear, with split-leg main units permitting an 18-in (46-cm) torpedo to be slung under the fuselage between them. Flotation bags were also fitted.

The Dart was a single-seat, equal-span biplane with Handley Page slots on the upper leading-edges of its folding wings to improve slow-speed handling. It was powered by a 450-hp Napier Lion IIB engine. It served with the Home Fleet from 1923-29 (461 and 462 Flights, aboard the *Furious*), and until 1933 with the Mediterranean Fleet (460 Flight

aboard the *Eagle*, and 463 and 464 Flights aboard *Courageous*). It began to be replaced in Fleet Air Arm service by the Ripon from 1928, but was not finally declared obsolete until April 1935.

There was a two-seat, dual-control version called the Velos, with twin-float landing gear and a Lion V engine, developed originally for the Greek air force, but used also in small numbers at a Blackburn-run training school for the RAF Reserve.

Span: 14.78 m (48 ft 6 in) *Length:* 10.82 m (35 ft 6 in) *Gross weight:* 2858 kg (6300 lb) *Maximum speed:* 171 km/h (106 mph)

Darter

American attack submarine. The *Darter* was one of the last conventional submersibles to be built for the US Navy. She was ordered under fiscal year 1954 as the first of three slightly improved *Tang* Class. Built by the Electric Boat division of General Dynamics, she was given the number SS.576 and launched in May 1956.

However, the realization of the potential of nuclear propulsion, with the commissioning of the *Nautilus* in 1954 and the high speeds obtained with the revolutionary 'tear-drop' hull of the *Albacore*, made it clear that the design was obsolescent. Accordingly only the *Darter* was completed, in order to test her exceptionally quiet Fairbanks-Morse diesels and Elliott electric motors. The funds for her sisters *Grayback* and *Growler* (SS.574 and 577) were diverted to convert the design to include Regulus surface-to-surface missiles.

The *Darter* resembles earlier conventional submersibles, with a streamlined bow, sail and fin-like domes for the Passive Underwater Fire-Control System (PUFFS) associated with her Mk 106 Mod II torpedo fire-control system and BQG-4 passive sonar. When completed in 1956 she was credited with 25 knots underwater, and was claimed to be the quietest submarine 'of all time'.

US Navy

Displacement: 1720/2388 tons (surfaced/submerged) *Length:* 81.9 m (268.8 ft) oa *Beam:* 8.3 m (27.23 ft) *Draught:* 5.8 m (19 ft) *Machinery:* 2-shaft diesel-electric, 4500 bhp/5600 shp= 19½/14 knots (surfaced/submerged) *Armament:* 8 21-in (53-cm) torpedo-tubes (6 bow, 2 stern, probably 24 torpedo carried) *Crew:* 87

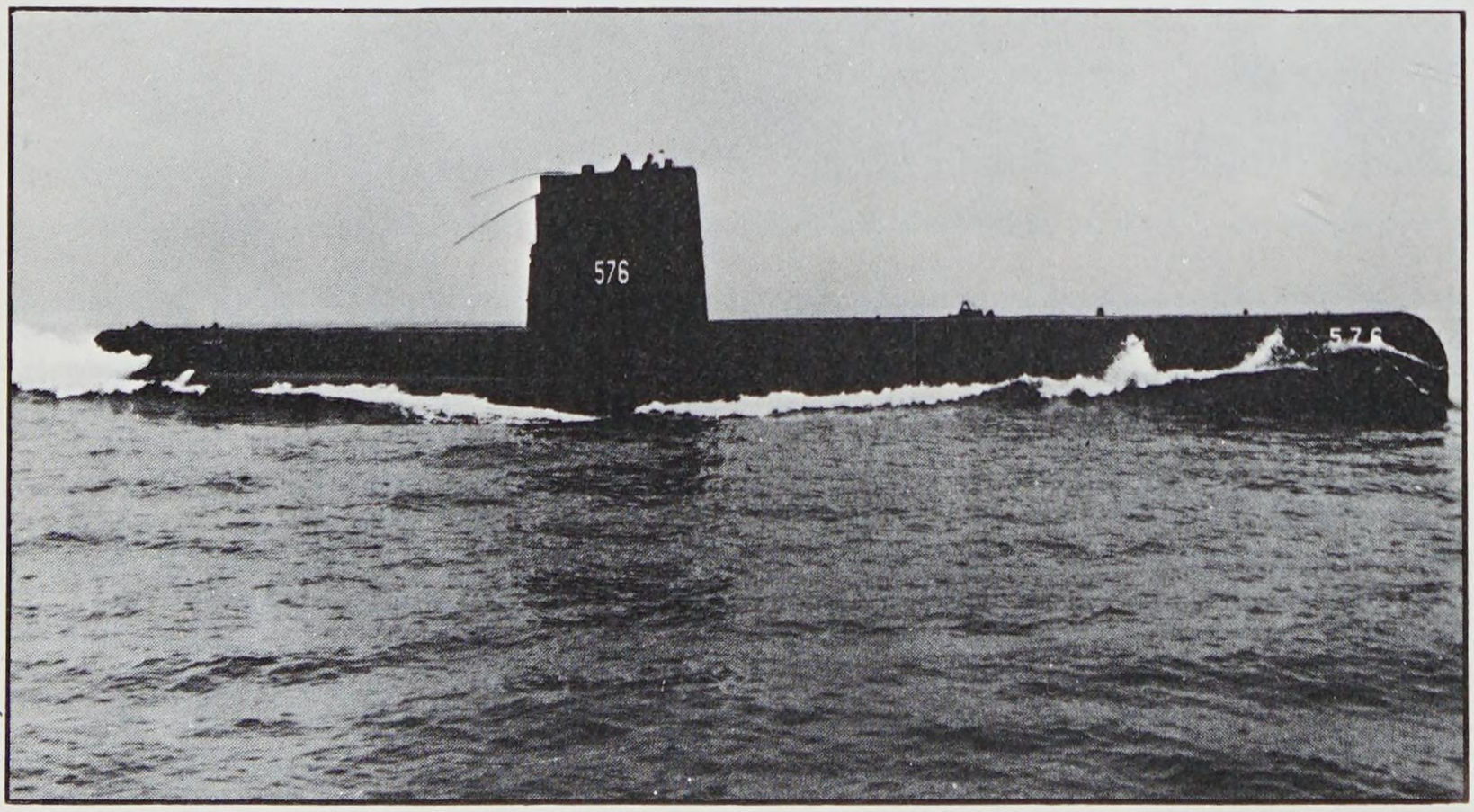
The USS *Darter* (SS.576), the last of the US Navy's conventionally-powered submarines

DASH

US remotely-controlled antisubmarine helicopter. At a time when remotely-piloted vehicles, particularly those which can take off and land vertically, are increasingly in the news, it is surprising to realise that the US was in the field as far back as 1958, when Gyrodyne was given a contract to develop a small drone helicopter as the airborne component of the DASH (Drone Anti-Submarine Helicopter) programme. The resulting QH-50 vehicle, originally powered by a single 72-hp Porsche piston engine, was derived from the company's earlier Rotorcycle and made the world's first free flight of an unmanned helicopter, in August 1960.

In its first production version, the QH-50C, a 300-shp Boeing T50 turboshaft engine was substituted to drive the twin coaxial rotors, and the first destroyer to become operational with torpedo-carrying drone helicopters did so in 1963. The idea, at least in the first instance, was to give a new lease of life to old destroyers by allowing them to attack submarines right out to maximum sonar range without embarking manned helicopters with the complexity of systems required to extend submarine detection and attack range on their own. Several hundred QH-50s were thus deployed, others serving on ASW ships.

In the DASH system, the parent ship hunted the target with its sonar. A deck control officer took the drone off using a transmitter with a control stick for cyclic roll, pitch and flat turns, and a knob for altitude and heading control. When the ship's radar



US Navy

US Navy Douglas Dauntless SBDs return from a bombing raid on a Japanese airfield on Truk

showed the helicopter to be near the target, control was transferred to a transmitter in the ship's combat information centre, which then launched the weapons. Recovery was the responsibility of the deck officer, who took control when he could see the drone.

The problems of integrating the control systems, coping with hostile targets and operating in high winds and seas can well be imagined—some would say they were never overcome—but more than 500 QH-50s, including many D versions with glassfibre rotor blades, more fuel and payload capacity, as well as uprated engines, were operational over a decade or so, and in 1978 some still survived in various research programmes carrying surveillance, target search, tracking and attack systems.

Rotor diameter: 6.1 m (20 ft) *Length without rotors:* QH-50C, 3.94 m (12 ft 11 in); QH-50D, 2.22 m (7 ft 3½ in) *Maximum takeoff weight:* QH-50C, 1036 kg (2284 lb); QH-50D, 1056 kg (2328 lb) *Maximum speed:* 150 km/h (93 mph) *Maximum range:* QH-50C, 132 km (82 miles); QH-50D, 227 km (141 miles)

Dassault French aircraft See **Etendard, Mystère, Ouragan, Super Mystère**

Dassault-Breguet French aircraft See **Alpha Jet, Mirage 2000, Mirage, Super Etendard**

Dat Assawari

Libyan frigate, built 1968-73. The British firm of Vosper Thornycroft, formed from the amalgamation of the long-established destroyer-specialists, John I Thornycroft and the MTB-specialists, Vosper, had previously produced a range of designs for small, well-armed warships. Starting with the 440-ton Mk I corvette, sold to Ghana in 1963, the firm's designers produced larger versions, up to frigate size.

The *Dat Assawari* is the Vosper Thornycroft Mk 7 design, generally similar to the Iranian Mk 5 of *Saam* Class, but beamier to allow about 20 tons more armament to be carried. The speed is slightly lower, as the displacement has been increased without modifying the basic Combined Diesel Or Gas Turbine (CODOG) propulsion outfit.

The ship is powered by twin Rolls-Royce Olympus gas turbines and twin Paxman Ventura diesels, driving controllable-pitch propellers through common reduction gearboxes. The gas turbines are used for high-speed running, and the diesels for cruising. The armament comprises a single Vickers 4.5-in (114-mm) Mk 8 gun forward, a twin Oerlikon-Bührle 35-mm (1.38-in) gun right aft, two single 40-mm (1.57-in) Bofors Mk 9 on the after superstructure, and a triple Seacat close range missile system forward of the bridge. In addition a Limbo Mk 10 depth-charge mortar is mounted in a well in the quarter-deck.

Sensors include a Plessey AWS-1 air-warning and surveillance radar, with its array mounted on a stump mainmast forward of the funnel, a fire-control director on the fore-mast, Decca RDL-1 passive radar-detection equipment, and a hull-mounted sonar.

The ship was laid down in September 1968, was launched in September 1969, and commissioned in February 1973. After a work-up at Portland, she sailed for Tripoli later that year. She was due to be refitted by Vosper Thornycroft in 1978-79, and may receive new equipment.

Displacement: 1325 tons (standard), 1625 tons (full load) *Length:* 101.6 m (333 ft 4 in) oa *Beam:* 11.08 m (36 ft 4¼ in) *Draught:* 3.4 m (11.2 ft) *Machinery:* 2-shaft gas turbine or diesel, 46,500 shp+3500 bhp=36 knots (17 knots on diesels) *Armament:* 1 4.5-in (114-mm) Mk 8; 2 40-mm (1.57-in)/60-cal (2×1); 2 35-mm (1.38-in) DP (1×2); 1 triple Seacat SAM launcher; 1 triple Limbo mortar *Crew:* 132

Dauntless, Douglas SBD

US Navy dive-bomber and reconnaissance aircraft. Development of this aircraft was begun in 1934 by Northrop Corporation (a subsidiary of Douglas Aircraft) based on its Army A-17A attack bomber, itself a derivative of the Gamma mailplane.

As the XBT-1, it flew for the first time in July 1935, powered by an 825-hp Pratt & Whitney R-1535-94 Twin Wasp Junior engine, driving a two-blade propeller and having semi-retractable landing gear which folded back into underwing fairings. There were 54 BT-1s ordered and 53 delivered; they had perforated dive-flaps replacing the original wing trailing-edge split flaps which had proved unstable in test flights. These remained a characteristic of the entire SBD series.

The final BT-1 was completed as an XBT-2, with inward-retracting main wheels and an 800-hp Wright XR-1820-32 Cyclone engine driving a three-blade propeller. Tests did not prove immediately satisfactory, and after many trials with different tail surface and aileron designs, it was redesignated XSBD-1 in final form. By this time, Northrop had become a division of the Douglas company.

In February 1939 Douglas received an order for 57 SBD-1s for the Marine Corps and 87 SBD-2s for the Navy. Now named Dauntless, deliveries to the USMC began in late 1940. Both versions were armed with two 0.30-in (7.62-mm) guns in the upper engine cowling, and the 454-kg (1000-lb) bomb carried on an under-fuselage cradle could be augmented by a 45.3-kg (100-lb) bomb on an outboard rack under each wing. The outer wing panels also contained additional fuel tanks, making a total of 795 litres (175 Imperial gal) in the SBD-1 and 1173 litres (258 Imperial gal) in the SBD-2. A further 0.30-in (7.62-mm) machine-gun was installed in the rear cockpit of the SBD-1 (two in the

Dauntless, Douglas SBD

SBD-2), and both were fitted with additional armour plating for crew protection.

Delivery of the SBD-2 to the US Navy was followed from March 1941 by 174 SBD-3s with 1000-hp R-1820-52 engines, reduced fuel (984 litres, 216 Imperial gal) and armed with 0.50-in (12.7-mm) forward-firing Browning machine-guns. These were in service at the time of the attack on Pearl Harbor and a further 410 were subsequently delivered.

During the Battle of the Coral Sea, SBDs from the USS *Lexington* and *Yorktown* were accredited with the destruction of 40 enemy aircraft, and at Midway the Japanese carriers *Akagi, Kaga* and *Soryu* were sunk by SBDs from the *Enterprise, Hornet* and *Yorktown.* Due to its consistent ability to absorb combat damage, the Dauntless did more to turn the tide of battle in the Pacific at this time than any other aircraft in service. It was also utilized to fly antisubmarine and close-support missions from the decks of escort carriers, armed with depth charges and rocket projectiles.

Seventy-eight SBD-3s, with the arrester gear removed and a pneumatic rear tire, were ordered by the USAAC in 1940, and designated A-24. These and a further 90, ordered later, were taken from Naval orders, suitably modified and issued to the Air Corps between June and October 1941. The A-24 did not achieve the combat success of its naval counterpart in the hands of Army pilots, and was used eventually for training duties, although a further 170 A-24A models were ordered.

The A-24A was the USAAF equivalent of the Navy's SBD-4, similar to the SBD-3 but

A flight of SBD Dauntless dive-bombers heads for the Japanese base at Palau in the Pacific

John Batchelor

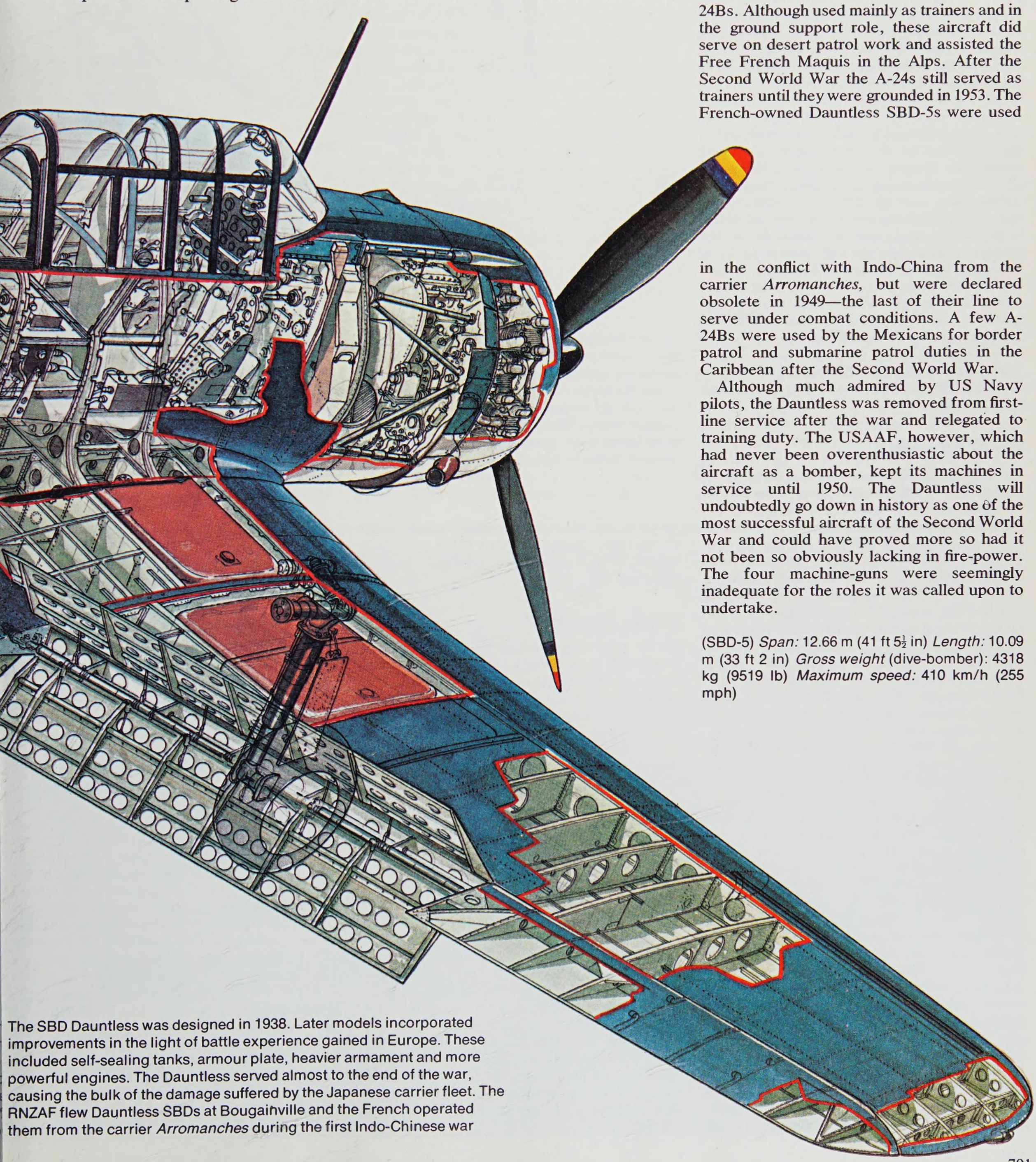
fitted with a 24-volt (instead of 12-volt) electrical system; delivery began in October 1942. The performance was improved by the installation of a Hamilton Standard Hydromatic constant-speed, twin-blade propeller. The US Navy and Marine Corps received 780 of this type.

It was followed in February 1943 by the major production version, the SBD-5 (615, as the A-24B, were delivered to the USAAF), with an uprated 1200-hp Wright R-1820-60 Cyclone radial engine, and fuel capacity increased to 1400 litres (308 Imperial gal). The Navy ordered 2965 SBD-5s; a further 60, designated SBD-5A, which had been built for the Army, were delivered instead to the Marine Corps. An SBD-5, powered by a 1350-hp Wright R-1820-66 engine, became the prototype for the SBD-6, used only by the US Navy and the Marine Corps; 450 of these were manufactured before Dauntless production ceased in 1944. A total of 5936 of all models, including those for the USAAF, were completed.

Several Allied air arms were supplied with the Dauntless. Great Britain received nine SBD-5s (Dauntless Mk I), but neither the Royal Navy nor the RAF used them in combat. The RNZAF took delivery of 18 SBD-3s and 23 SBD-5s; the latter gave noteworthy service at Bougainville in March 1944. The French navy had 32 SBD-5s and the Armée de l'Air between 40 and 50 A-24Bs. Although used mainly as trainers and in the ground support role, these aircraft did serve on desert patrol work and assisted the Free French Maquis in the Alps. After the Second World War the A-24s still served as trainers until they were grounded in 1953. The French-owned Dauntless SBD-5s were used in the conflict with Indo-China from the carrier *Arromanches*, but were declared obsolete in 1949—the last of their line to serve under combat conditions. A few A-24Bs were used by the Mexicans for border patrol and submarine patrol duties in the Caribbean after the Second World War.

Although much admired by US Navy pilots, the Dauntless was removed from first-line service after the war and relegated to training duty. The USAAF, however, which had never been overenthusiastic about the aircraft as a bomber, kept its machines in service until 1950. The Dauntless will undoubtedly go down in history as one of the most successful aircraft of the Second World War and could have proved more so had it not been so obviously lacking in fire-power. The four machine-guns were seemingly inadequate for the roles it was called upon to undertake.

(SBD-5) *Span:* 12.66 m (41 ft 5½ in) *Length:* 10.09 m (33 ft 2 in) *Gross weight* (dive-bomber): 4318 kg (9519 lb) *Maximum speed:* 410 km/h (255 mph)



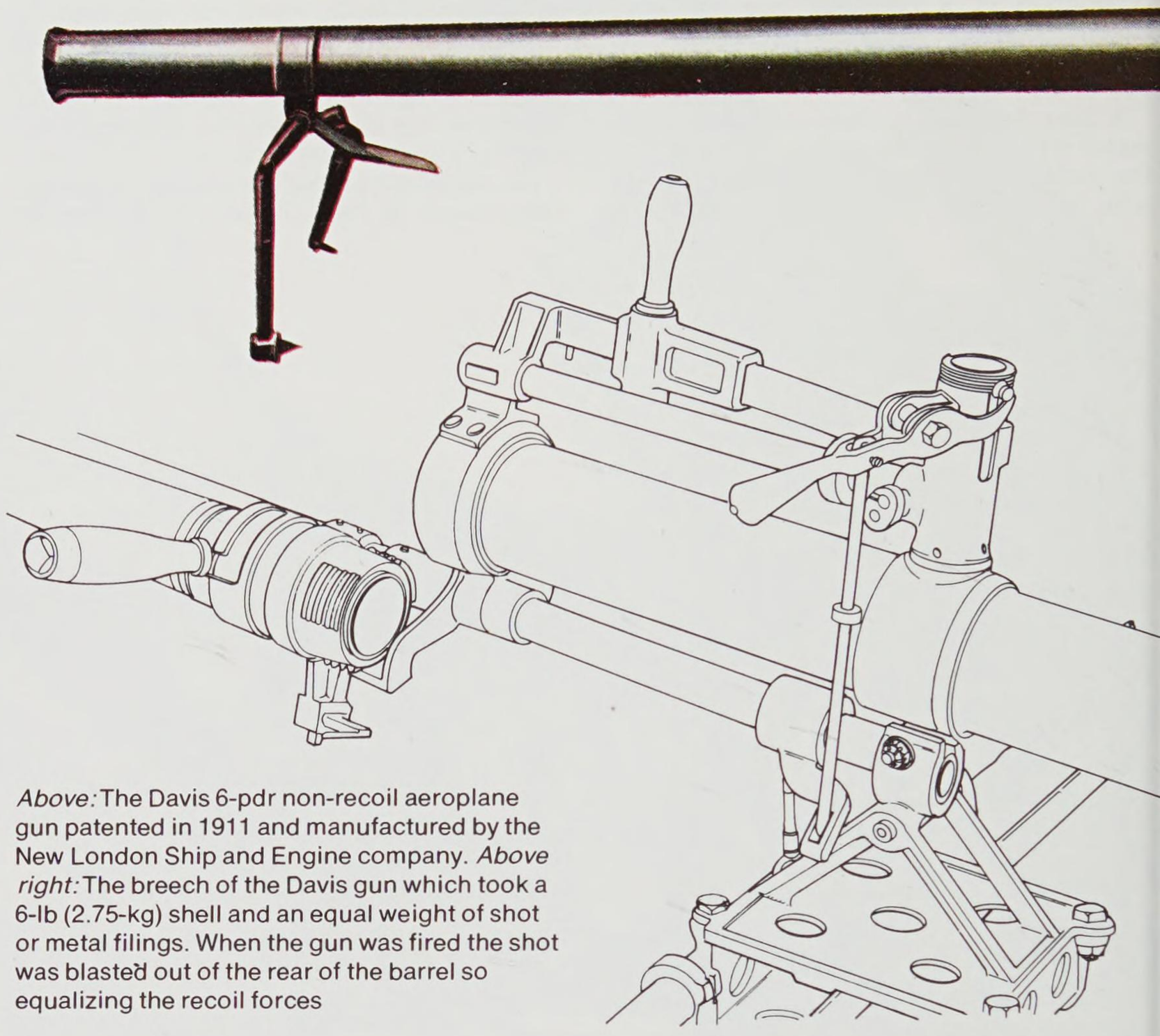
The SBD Dauntless was designed in 1938. Later models incorporated improvements in the light of battle experience gained in Europe. These included self-sealing tanks, armour plate, heavier armament and more powerful engines. The Dauntless served almost to the end of the war, causing the bulk of the damage suffered by the Japanese carrier fleet. The RNZAF flew Dauntless SBDs at Bougainville and the French operated them from the carrier *Arromanches* during the first Indo-Chinese war

Davis

US recoilless aircraft guns. The first practical recoilless guns, these early aircraft weapons were the invention of USN Commander Cleland Davis. His first patent was taken out in 1911 for a one-shot weapon built in a 3.05-m (10-ft) tube: when fired, the projectile was blown through the forward end and the remainder of the gun through the other. This wasteful system was soon replaced by twin barrels pointing in opposite directions with a connecting breech between. The round, consisting of a central cartridge attached to a shell on one side and an equal-weight steel countershot on the other, was loaded into the breech, which broke clear of the barrels. When the cartridge was fired, the projectile was blown forward while the countershot was expelled to the rear. Since an equal weight was fired in each direction, the recoil of each barrel cancelled out that of the other.

The guns were developed in 2-pdr, 6-pdr and 12-pdr versions and were manufactured both in the United States and under licence in Britain, where they do not appear to have been used operationally. In American installations the Davis was often combined with a Lewis machine-gun with barrels aligned: the Lewis was used to ensure correct aim before the heavy weapon was fired.

(2-pdr) *Overall length:* 213.36 cm (84 in) *Weight:* 23.59 kg (52 lb) *Muzzle velocity:* 365 m/sec (1197 ft/sec)



Above: The Davis 6-pdr non-recoil aeroplane gun patented in 1911 and manufactured by the New London Ship and Engine company. *Above right:* The breech of the Davis gun which took a 6-lb (2.75-kg) shell and an equal weight of shot or metal filings. When the gun was fired the shot was blasted out of the rear of the barrel so equalizing the recoil forces

Davy Crockett

US short-range nuclear weapon. Davy Crockett was a recoilless rifle (available in two versions, either mounted on a Jeep or transported manually) which could fire rocket-powered projectiles carrying nuclear or conventional warheads. The weapon was designed to provide infantry and armoured forces with close support, being used to attack pillboxes, artillery positions, bunkers, tanks, massed infantry, command posts and supply dumps. Davy Crockett was deployed with the US 7th Army in Germany during 1962, but was withdrawn from service prematurely because of an unwillingness to place nuclear weapons under the direct control of junior commanders.

Davy Crockett, developed by the US army Weapons Command at Rock Island arsenal, was produced in light and heavy versions. Each carried a 279-mm (11-in) supercaliber warhead with a yield of less than one kiloton; the same warhead was also used in the US Air Force's AIM-26A Nuclear Falcon air-to-air missile and the Genie air-to-air rocket. The effective blast radius was 182-549 m (200-600 yards) and negligible radiation was produced. The system was tested operationally in the presence of troops at the US Atomic Energy commission's Nevada test site during exercise Ivy Flats in July 1962.

Davy Crockett was one of the first major military applications of titanium, which was adopted to reduce weight and prevent corrosion. The weapon was the smallest nuclear delivery system ever deployed.

Length: launcher—about 1.5 m (5 ft); warhead—about 76 cm (30 in) *Weight:* light model—about 68 kg (150 lb); heavy model--about 170 kg (375 lb) *Propulsion:* solid rocket motor *Range:* light model—2000 m (2185 yd); heavy model—4000 m (4370 yd) *Warhead:* nuclear, about 0.5 KT

DB-3, Ilyushin

Soviet long-range medium bomber. The DB-3 competed successfully in 1935, against a design by Pavel Sukhoi of the Tupolev design bureau, to meet a Soviet air force requirement for a medium bomber capable of carrying a 1000-kg (2205-lb) bombload over a 3000-km (1864-mile) range at a speed of not less than 350 km/h (217 mph).

Designed under Sergei Ilyushin's leadership at the TsKB (Tsentral'noe Konstruktorskoe Byuro—Central Design Bureau) in 1933-34, the first prototype, designated TsKB 26, began flight testing in 1935. Powered by two 800-hp Gnome-Rhône 14K radial engines, it demonstrated a range of 4000 km (2485 miles) with a 500 kg (1102 lb) load, at a speed of 320 km/h (199 mph).

The second prototype, designated TsKB 30, differed in having 760-hp M-85 engines (licence-built equivalent of the Gnome-Rhône 15 Krsd), an enclosed crew compartment, all-metal, instead of wooden, rear fuselage, and redesigned vertical tail surfaces. This aircraft, like its predecessor, set up several international performance records, and with very little further alteration was accepted for production, which began in 1936 under the Soviet air force designation DB-3B.

An all-metal low-wing monoplane, the DB-3B began to enter Soviet air force service in the following year, and a total of 1528 of this version were completed. Later production aircraft had the more powerful (950-hp) M-86 engine developed by Tumansky from the M-85. Armament consisted of three 7.62-mm (0.30-in) ShKAS machine-guns, one mounted in the nose turret, another in a manually-operated dorsal turret, and the third firing downward through a trap-door in the fuselage floor. Two 1000-kg (2204-lb), three 500-kg (1102-lb) or ten 100-kg (220-lb) bombs could be accommodated in the internal bomb bay and, for short-range attacks, up to 1500 kg (3307 lb) additional load could be attached externally below the wing centre-section.

Unladen, the DB-3B was extremely manoeuvrable (as test pilot Vladimir Kokkinaki had proved in 1936 by looping the TsKB-26), and it could withstand considerable battle damage. Its primary objective was long range, to which purpose an internal fuel capacity of 3600 litres (792 Imperial gal) could be supplemented by two 400-litre (88-Imperial gal) under-fuselage auxiliary tanks, giving a maximum range of 3000 km (1864 miles).

A DB-PT twin-float torpedo-bomber prototype appeared in 1938. No production of this was undertaken, though torpedo carrying became one of the many functions of the landplane DB-3 models used by Soviet naval aviation. The DB-3B itself was operational during the 'winter war' of 1939-40 against Finland, and for a short time against Nazi Germany; but by mid-1941 it had been largely

supplanted by its much-improved development, the DB-3F or Il-4, production of which continued until 1944.

Span: 21.40 m (70 ft 2½ in) *Length:* 14.30 m (46 ft 11 in) *Gross weight (max):* 9700 kg (21 385 lb) *Maximum speed:* 408 km/h (253 mph)

DB-7 US Navy designation for Douglas Havoc fighter/attack bomber See **Havoc**

DC.I, Fokker

Dutch fighter/reconnaissance aircraft. First flown in 1923, the DC.I prototype (H-NABZ) competed successfully later that year for a Spanish army order, and a small number were subsequently licence-built in Madrid. In Holland, the NV Vliegtuigen Fokker built 10, which were supplied in autumn 1925 to the Dutch East Indies army air service. A two-seat, single-bay biplane, the DC.I was essentially a short-span variant of the successful C.IV reconnaissance aircraft. It was powered by a 450-hp Napier Lion engine, driving a two-blade propeller, and was armed with two light machine-guns, fired by the pilot, mounted beneath the upper engine cowling, and two on a movable mounting in the observer's cockpit at the rear.

Span: 11.43 m (37 ft 6 in) *Length:* 9.15 m (30 ft) *Gross weight:* 1826 kg (4026 lb) *Maximum speed:* 238 km/h (149 mph)

Deacon

British self-propelled antitank gun. Properly known as the Carrier AEC 6-pdr Gun Mk 1, Deacon was a 6-pdr antitank gun mounted on a turntable on the back of an AEC Matador truck. A shield was constructed on the gun mounting to protect the gun detachment, and the vehicle was also protected with armour around the driver's cab and engine.

In 1942, 175 Deacons were built, the majority of which were sent to the Middle East for service in the Western Desert. The basic design seems to have stemmed from the contemporary 'tank destroyer' theory, which visualized fast mobile guns outflanking tanks and confounding them with their power of manoeuvre. Unfortunately, it did not work out quite like that.

The Deacon had a very high silhouette and poor crosscountry ability in the desert and, in spite of courageous handling, it was rarely put to good effect. In different terrain it might have been more successful, but in the desert it was too vulnerable. It was withdrawn at the end of the North African campaign, its place being taken by the 17-pdr Archer, a tracked vehicle with better protection and agility.

Dealer

British torpedo project of 1943. Work on the Bowler torpedo in 1942 led to the pooling of resources under the code-name 'Joker', to develop a homing version of the 18-in (46-cm) Mk 15 torpedo. When the designers ran into trouble with reverberation, self-noise and water-entry shock, the programme was reviewed, and as a result two separate programmes began. One was called Trumper, an active homer, and the second was called

The Fokker DC.I, a single-bay two-seat fighter/reconnaissance biplane, was essentially a short-span variant of the C.IV reconnaissance aircraft

Dealer, a passive surface-launched weapon.

Most of the work was done at RAF Halton and later at Titchfield. The first batch of torpedoes was produced by the RAF, but the first production order for 100 weapons was taken over by the RN torpedo-factory early in 1945.

The Dealer was one of the most unusual torpedoes of the Second World War. It had been redesigned to allow it to be dropped from an aircraft, and had parachute-retardation. Unlike its contemporaries, it had no control surfaces, and was steered by two propellers set in tandem on each side of a fixed rudder, each with its own independently energised motor. Steering in azimuth was achieved by varying the voltage; depth-control was by moving the main battery to-and-fro, and thus altering its centre of gravity. The body of the torpedo was tapered slightly from nose to tail.

All 100 Dealers were scrapped soon after production and were never operational. However, Dealer B was developed from the idea by Squadron Leader Robertson who had worked on the original programme in 1942. It finally evolved as an eight-finned passive homing torpedo, driven by two conventional propellers. The operational version was known as the 18-in (46-cm) Mk 30, and it was passed for issue to the Fleet in June 1954.

The Mk 30 Mod I version was given improvements calculated to provide a hit-probability superior to any torpedo in existence, and several prototypes were built and tested. In 1955, the project was cancelled, and 50 US-pattern Mk 43 torpedoes were bought instead. The contract for their 'anglicization' was given to Plessey Marine in 1956, to provide a stop-gap until the purchase of the new USN Mk 44. However, this did not materialize for another ten years. The folly of this decision is even harder to comprehend in the light of tests on the Mk 43, which showed that it had only one-quarter the hit-probability of the Mk 30 in its original unimproved form.

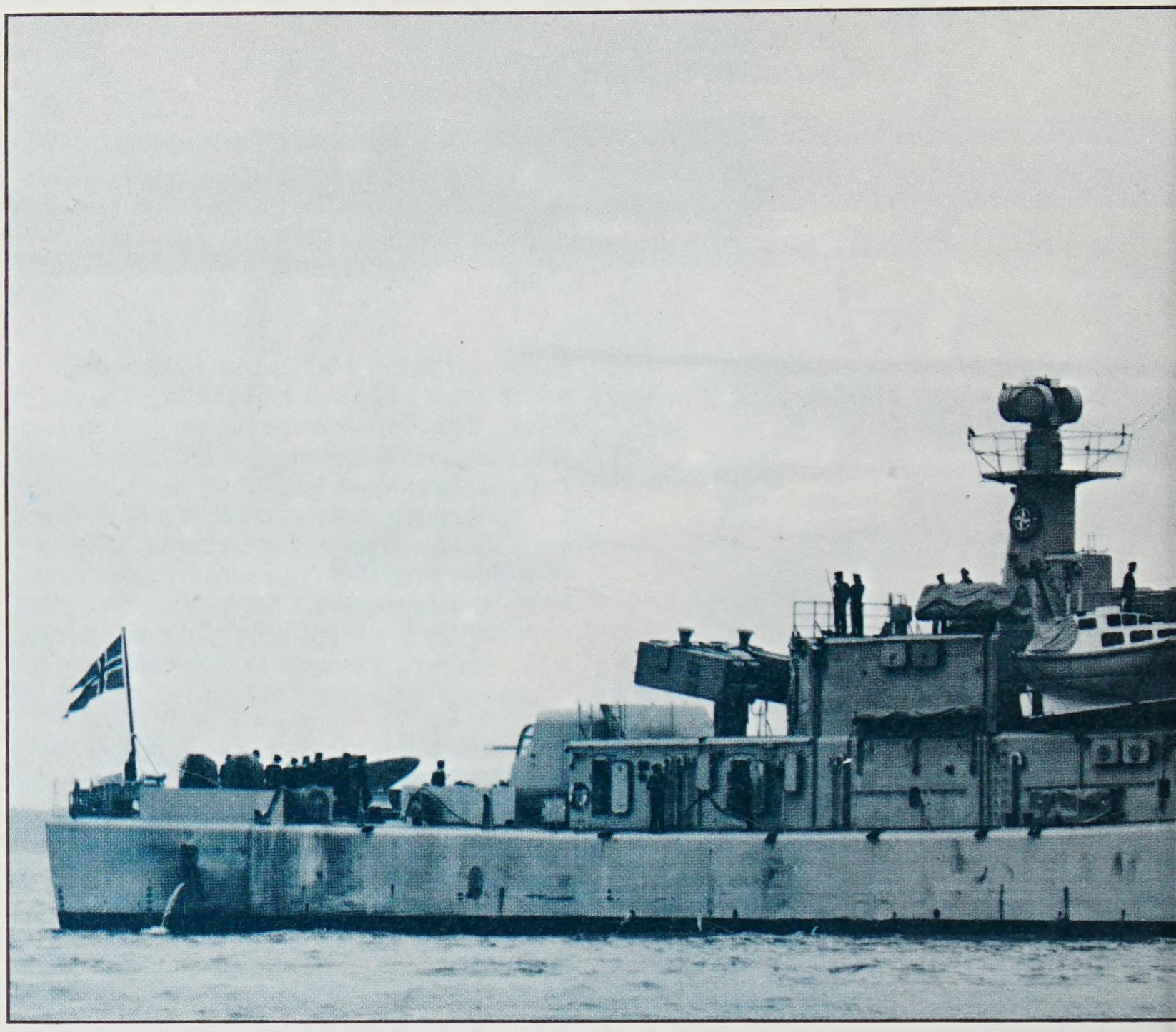
See also Bidder and Trumper.

Dealey

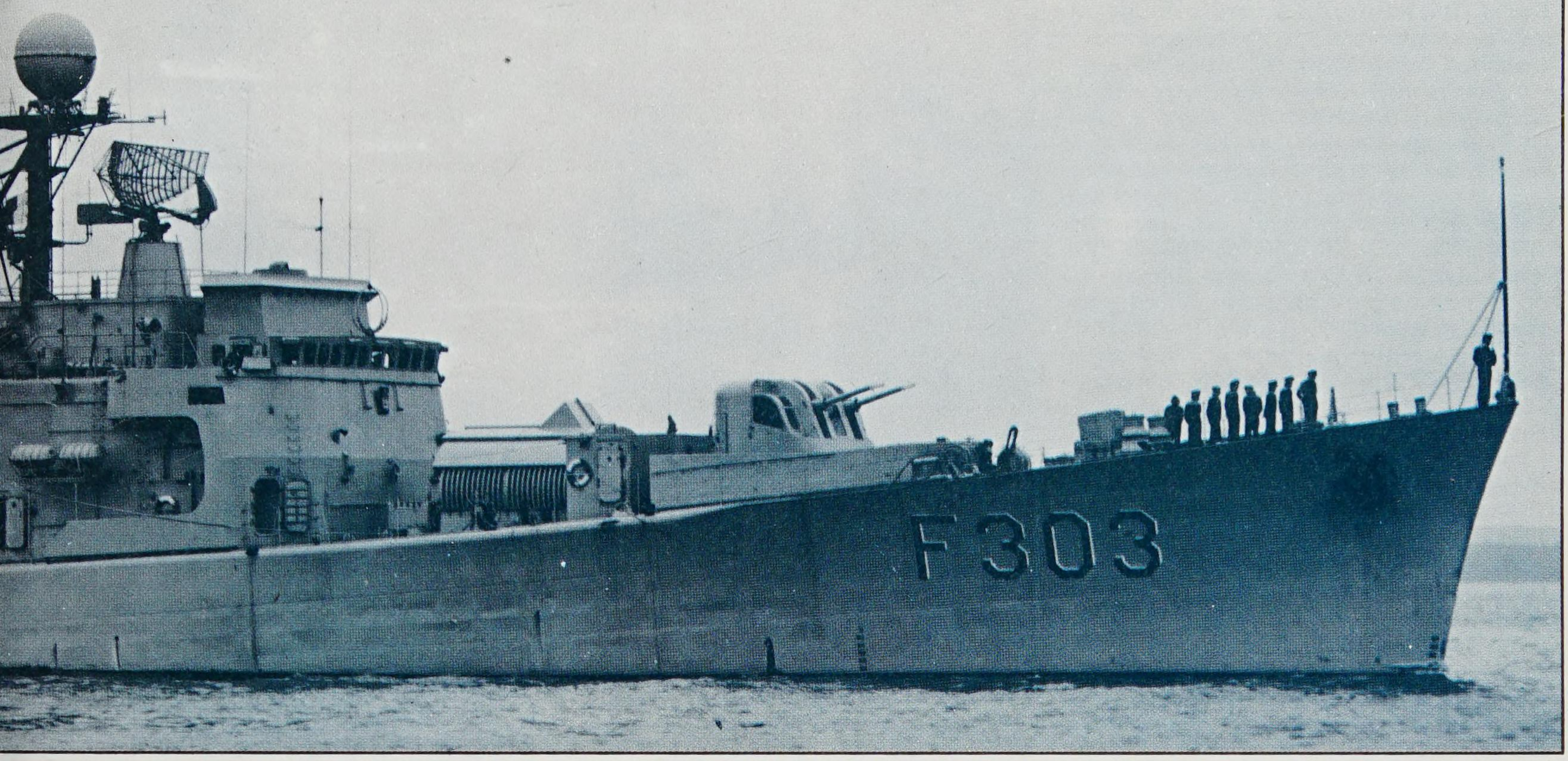
US destroyer escort class. Immediately after the Second World War the US Navy had a large surplus of brand-new wartime DEs, and it was not until the Korean war that it was decided to build a new class of DE incorporating all the latest improvements in weapons, machinery and shipbuilding techniques. Three *Dealey*s were built between 1952-55 by Bath Iron Works, and ten of the almost identical *Courtney* Class were built in various yards from 1955-1958.

The *Dealey*s were based on the Second World War DEs, having much the same layout and a similar but slightly longer hull. However, the main problem in producing the wartime ships had been the difficulty of manufacturing sufficient machinery, so the *Dealey*s were the first US DEs to adopt a single-shaft layout. The greater risk of total breakdown or of immobilization by battle damage was considered to be outweighed by the greater ease of production and the small size, simplicity and cheapness of the machinery.

Initially the *Dealey*s and the *Courtney*s were armed with a twin 3-in (76-mm)/50-cal

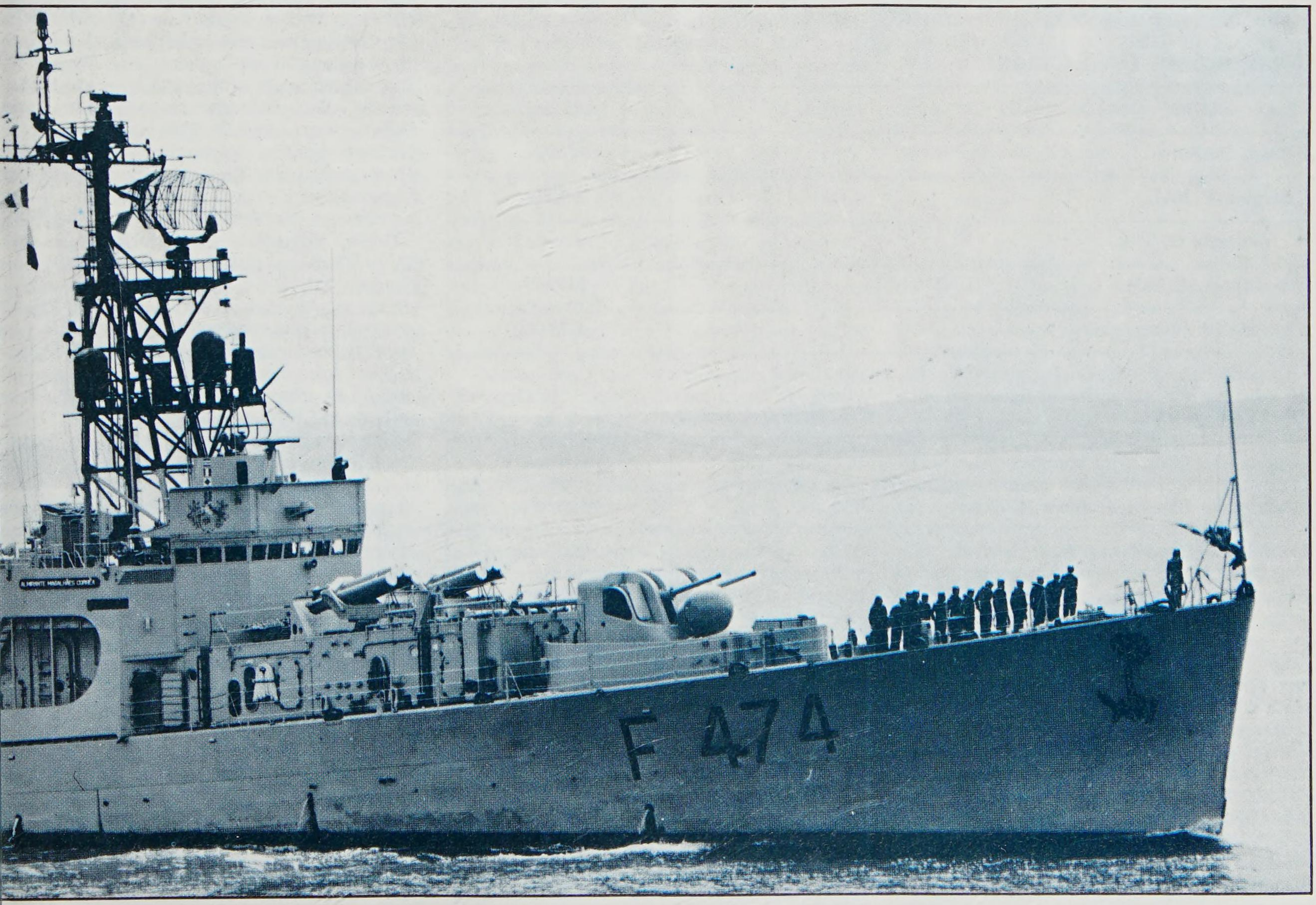


Above: Stavanger, **one of five *Oslo* Class frigates (modified American *Dealey* Class) built in Norway by Marinens Hovedverft, Horten, and partly financed by the US Government**



C & S Taylor

Below: **The Portuguese frigate *Almirante Magalhaes Correa,* a modified *Dealey* Class vessel built by Portugal in the mid-1960s. Though these ships were laid down in the early 1960s at yards in Lisbon and Viano do Castelo, parts had already been prefabricated a year earlier**



C & S Taylor

US *Dealey* Class

Name and No	launched
Dealey **(DE.1006)**	11/1953
Cromwell **(DE.1014)**	6/1954
Hammerberg **(DE.1015)**	8/1954

US *Courtney* Class

Name and No	launched
Courtney **(DE.1021)**	11/1955
Lester **(DE.1022)**	1/1956
Evans **(DE.1023)**	9/1955
Bridget **(DE.1024)**	4/1956
Baver **(DE.1025)**	6/1957
Hooper **(DE.1026)**	8/1957
John Willis **(DE.1027)**	2/1956
Van Voorhis **(DE.1028)**	7/1956
Hartley **(DE.1029)**	11/1956
J K Taussig **(DE.1030)**	1/1957

Norwegian *Oslo* Class

Name and No	launched
Oslo **(F 300)**	1/1964
Bergen **(F 301)**	8/1965
Trondheim **(F 302)**	9/1964
Stavanger **(F 303)**	2/1966
Narvik **(F 304)**	1/1965

Portuguese *Almirante Pereira da Silva* Class

Name and No	launched
Almirante Pereira de Silva **(F 472)**	12/1963
Almirante Gago Coutinho **(F 473)**	8/1965
Almirante Magalhàes Correa **(F 474)**	4/1966

mount fore and aft with a Weapon Able (Weapon Alpha) A/S rocket launcher between the forward gun mount and the bridge. *Dealey* herself ran trials for a time with the British Squid A/S launcher in its place. They also had fixed A/S torpedo tubes. The superstructure was aluminium to save topweight, and they had a lattice mast to carry the extensive electronic antennae.

The Portuguese *Almirante Pereira da Silva* Class frigates are virtual copies of the *Dealey*s, using US equipment and armament but with two Bofors four-barrelled A/S mortars replacing the Weapon Alpha forward. The Norwegian *Oslo* Class frigates are also based closely on the *Dealey*s but with a modified superstructure and new armament comprising an octuple NATO Sea Sparrow SAM launcher, six Penguin surface-to-surface missile launchers and a Terne six-barrelled A/S rocket launcher in addition to the two twin 3-in guns and two triple A/S torpedo tubes. The Portuguese vessels were built by Estaleiros Navais, Lisbon, and the Norwegians by Marinens Hovedverft Horten.

Most of the *Dealey*s and *Courtney*s were modernized in the late 1960s. The aft 3-in (76 mm) mount was removed and a hangar and pad for two DASH helicopters was installed aft of the funnel. The electronics were updated and the fixed tubes were replaced by two triple Mk 32 A/S torpedo launchers amidships. However, DASH was a failure and the *Dealey*s and *Courtney*s were too slow and too small for modern A/S warfare. As a result, the US Navy discarded or transferred all its early postwar DEs in the early 1970s. By 1977 none remained in service with the USN. *Dealey* herself was purchased by Uruguay in July 1972 and renamed *18 de Julio*.

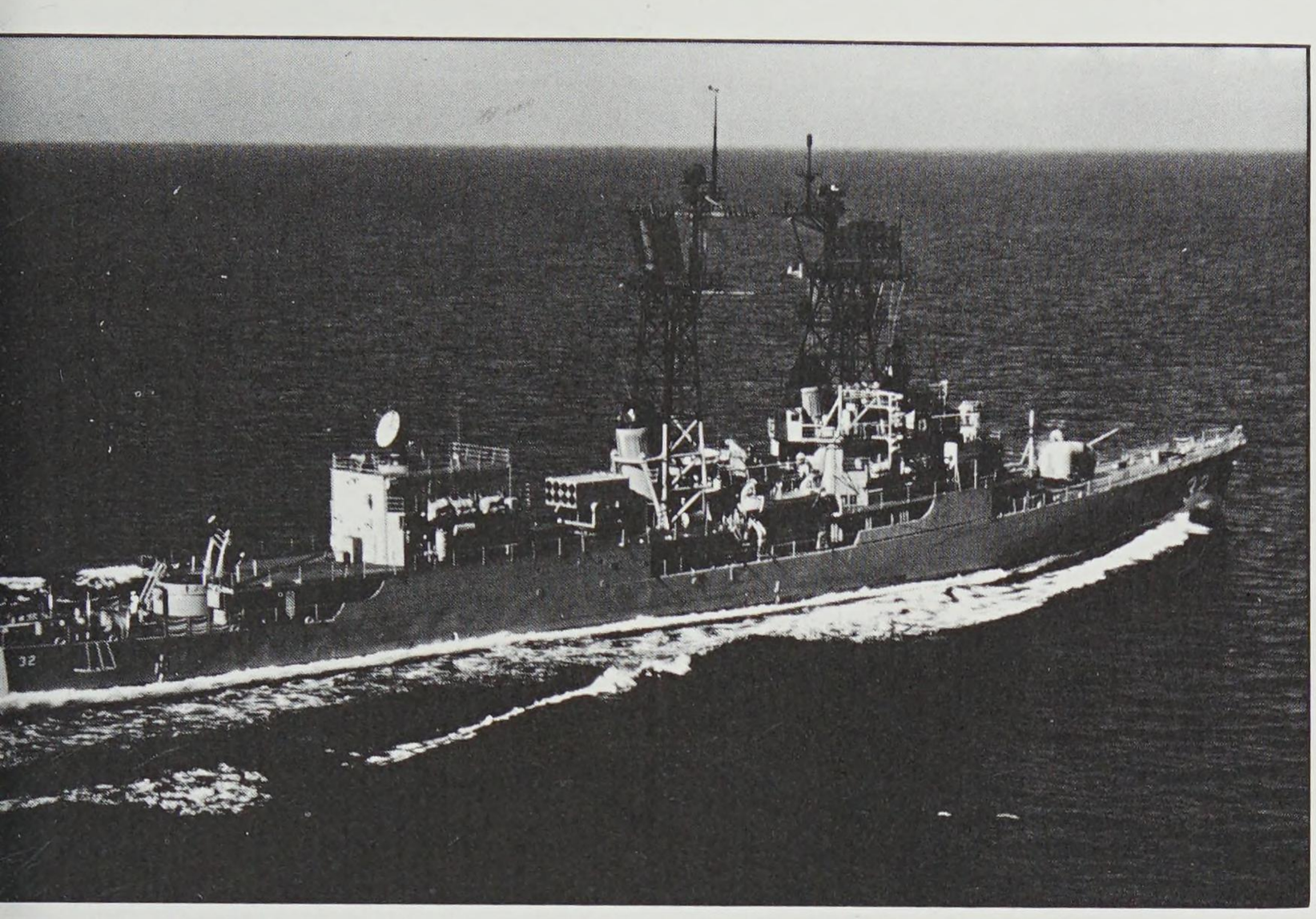
Displacement: 1450 tons (standard), 1914 tons (full load) *Length:* 95.8 m (314 ft 6 in) oa *Beam* 11.2 m (36 ft 10 in) *Draught:* 4.2 m (13 ft 8 in) *Machinery:* 1-shaft geared steam turbine, 20 000 shp=25 knots *Armament:* 2 3-in (76-mm); 1 Weapon Alpha; 2 triple 12.7-in (32.25-cm) torpedo tubes *Aircraft:* 2 DASH helicopters *Crew* 149-170

Decatur

US guided-missile destroyer class. The four *Decatur* Class DDGs are guided-missile conversions of the *Forrest Sherman* Class destroyers. The *Forrest Sherman* Class were the first US post-Second World War destroyers and were basically enlarged and improved *Gearing*s with a single 5-in (127-mm)/54-cal gun forward and two, together with a twin 3-in (76-mm)/50-cal mount aft. They had aluminium upperworks and improved electronics. Eighteen *Forrest Shermans* were built between 1953-59. The later ships incorporated various improvements and from *Decatur* onwards they were completed with higher bows.

Between 1965-68 *Decatur* (DDG-31, ex-DD-936), *John Paul Jones* (DDG-32, ex-DD-932), *Parsons* (DDG-33, ex-DD-949) and *Somers* (DDG-34, ex-DD-947) were converted into guided-missile destroyers. The aft guns were removed and replaced by a new superstructure and a single Tartar Mk 13 Mod 1 SAM launcher, which has a magazine for about 40 missiles. It had originally been intended to fit these conversions with DASH helicopters for long range A/S work, but by the late 1960s it was apparent that DASH was a complete failure, so an 8-tube Asroc launcher was fitted aft of the second funnel instead. Two triple Mk 32 A/S torpedo launchers were mounted in front of the bridge for close-range A/S work. During the conversion the electronics were updated and two large lattice masts replaced the original tripods. They now carry the SPS-48 3-D search radar.

It had originally been intended to convert the *Forrest Sherman* Class into either specialist AA or A/S destroyers. *Turner Joy* (DD 951) was earmarked to be the next DDG conversion, but the cost and time taken to convert the first four into DDGs was such that it was not considered cost effective to convert any more in this way. However, the simpler and cheaper A/S conversion was more effective and eight were converted into specialist A/S destroyers between 1967-71.



US Navy

The *John Paul Jones* (DDG-32), an ex-*Forrest Sherman* converted to a *Decatur* Class

Displacement: 4150 tons (full load) *Length:* 127.5 m (418 ft 4 in) oa *Beam:* 13.4 m (44 ft) *Draught:* 6.1 m (20 ft) *Machinery:* 2-shaft geared steam turbines, 70000 shp=32.5 knots *Armament:* 1 Tartar SAM launcher; 1 5-in (127-mm) gun; 1 Asroc launcher; 2 Triple 12.7-in (32.26-cm) torpedo tubes *Crew:* 337-364

Dedalo

Spanish seaplane carrier. *Dedalo* was built by the British firm of Swan Hunter in 1901 as the German merchant ship *Neuenfels*. She was interned in Spain in 1914 when she elected not to run the Allied blockade of Germany with her cargo of refugees. After the First World War she was transferred to Spain along with five other German merchant ships as *España No 6* in reparation for Spanish ships sunk by German U-Boats.

España No 6 was incorporated into the Spanish navy in September 1921, and she was rebuilt as a seaplane and balloon carrier and renamed *Dedalo* in 1922. The forward holds were converted into storage space and handling area for two 42 m (137 ft 9½ in) non-rigid airships, though only one could be dealt with at a time. The forward masts and derricks were removed and an airship mooring mast was mounted near the bows.

Aft of the bridge the upperworks were completely rebuilt. A hangar was fitted for seaplanes and this was connected to the flight deck above it by a lift. The flight deck extended from the bridge to the stern, and was used for marshalling and storing the seaplanes, which took off and landed in the water. A mast was fitted either side of the aft end of the bridge, and they were connected by latticework. Derricks from these masts lifted the seaplanes in and out of the water.

The aircraft could be maintained in the hangar, and in the forecastle there was a plant for producing hydrogen for the airships. Although the number of seaplanes that could be operated at any one time was severely restricted by the space available on board in the hangar and on the flight deck, extra aircraft could be stored disassembled in the hold. She usually operated Italian Savoia 16 and Macchi 18 aircraft. *Dedalo*'s gun armament was restricted to two single Krupp 4.1-in (105-mm) guns in the bows and two Nordenfelt 57-mm (2.24-in) guns on the poop under the flight deck.

After making a tour of Spain's Mediterranean and Atlantic ports, *Dedalo* took part in a ceremonial visit to Italy in November 1923. She saw active service during the Riff rebellion, where her aircraft were used to provide reconnaissance and ground support. She was not used much after that, but in 1934 she was used for experiments with an autogyro designed by Juan de la Cierva. On March 7, 1934, this was flown off her flight deck for the first time while she was at anchor in Valencia harbour. However, these experiments could not be followed up because of the Civil War, and in any case *Dedalo* herself was really unsuited for operating an autogyro underway because her flight deck was aft of the bridge, and the autogyro's free-spinning rotor demanded a takeoff into the wind.

During the Civil War *Dedalo* was badly damaged in Valencia harbour, and she broke in two and sank in shallow water. She was formerly discarded on March 1, 1940.

Displacement: 10800 tons (standard) *Length:* 128 m (420 ft) *Beam:* 16.76 m (55 ft) *Draught:* 6.25 m (20 ft 6 in) *Machinery:* 1-shaft steam quadruple-expansion reciprocating, 3000 ihp=12.5 knots *Armament:* 2 4.1-in (105-mm); 2 57-mm (2.24-in) *Aircraft:* 2 non-rigid airships; 25 aircraft *Crew:* 350

Dedalo

Spanish helicopter carrier. *Dedalo* (PH-01) was originally ordered by the US navy as the *Cleveland* Class light cruiser *Wilmington* (CL-79). In March 1942 she was reordered as one of the nine *Independence* Class carriers. She was laid down by the New York Shipbuilding Corporation as *Cabot* (CVL-28), launched on April 4, 1943 and completed on July 24, 1943. The *Cleveland* hull had large bulges added and a hangar and wooden flight deck with four small funnels to starboard replaced the cruiser upperworks. She took part in the Pacific island-hopping campaign and was damaged by a kamikaze aircraft off Luzon on November 25, 1944.

In the early 1950s *Cabot* was modified as an ASW carrier. Her flight deck and hangar deck were modified to take heavier aircraft, a large portside catapult was added, two funnels were removed, her AA armament was reduced, her electronics were updated and her internal arrangements were modernized. However, she was really too small for this role and in May 1959 she was reclassified as an aircraft transport (AVT-3). *Cabot* was then put into reserve.

Spain asked the United States for the loan of an A/S helicopter carrier in the mid-1960s, and although the rebuilt escort carrier *Thetis Bay* was originally chosen, it was eventually decided to transfer *Cabot* instead. She was refitted, renamed *Dedalo*, and formally transferred on August 30, 1967 for five years. She was purchased by Spain in December 1973.

She operates Sea King A/S helicopters, but can embark other types for assault landings. A squadron of AV-8As (the US version of the Harrier) was formed in the late 1970s, and was due to operate from *Dedalo*. The AV-8A has been renamed the Matador by the Spanish. This will considerably upgrade the capabilities of the Spanish navy, and will make Spain the second Western country after the US to have a seaborne V/STOL strike force. *Dedalo* is the flagship of the fleet.

Displacement: 13000 tons (standard), 16416 tons (full load) *Length:* 189.9 m (623 ft) oa *Beam:* 33.2 m (109 ft) flight deck *Draught:* 7.92 m (26 ft) *Machinery:* 4-shaft geared steam turbines, 100000 shp=32 knots *Protection:* 51-127 mm (2-5 in) sides; 51-76 mm (2-3 in) deck *Armament:* 26 40-mm (1.57-in) *Aircraft:* 7 Matadors; 20 helicopters *Crew:* 1112

DEFA

French aircraft guns. Like the British Aden, the DEFA (Direction des Etudes at Fabrication d'Armement—directorate of arms studies and manufacture) gun was developed directly from the German Mauser MG 213 of 1944. The original model was interchangeable with the Aden Mks I-V and uses similar 30-mm (1.18-in) ammunition belt-fed from either side at rates of fire approaching 1200 rds/min. After being rammed through the disintegrating link belt into one of the five chambers of the revolving breech cylinder, which occupies two stages of the cylinder's rotation, the round is brought in line with the barrel and fired electrically. On the remaining two stages of rotation, gas tapped from a vent operates the mechanism to eject the spent cartridge. A solid-fuel cartridge provides for in-flight recocking in the event of a stoppage.

The series of DEFA cannon comprises the original Model 550; the 552 and long-life 552A which are standard equipment on the delta-wing Mirage III and 5; the 553, with nitrochrome barrel and advanced muzzle unit which is fitted to French Jaguars, Alpha Jets and Mirage Fls and Israeli A-4 Skyhawks; and the lightweight 554, weighing only 85 kg (187 lb), which has a rate of fire of 1800 rds/min.

The normal range of ammunition is available—armour-piercing, high-explosive, incendiary and so on—and controls allow maximum burst lengths of 0.5 or one second or continuous fire, though the last would not normally be used in combat.

Defence

British cruiser class. The three ships of this class, ordered under the 1904-05 Programme, were laid down in 1905 and completed in 1908. All were built in Royal dockyards, *Defence* at Pembroke, *Minotaur* at Devonport and *Shannon* at Chatham. They were the last and largest armoured cruisers to be built for the Royal Navy and were generally similar to the previous *Warrior* Class, but had more weight devoted to armament and less to protection.

They carried four 9.2-in (234-mm) guns in twin turrets mounted fore and aft, which provided the same number per broadside as the six single turrets of the *Warrior*, while the number of 7.5-in (190-mm) single gun turrets on each side was increased from two to five. The distribution of hull protection was as that of the *Warrior*, except that no side armour was provided above the main deck in order to compensate for the additional weight of the armament and its armour.

In the *Shannon*, an attempt was made to improve speed by modifying her hull form. However, with 3.2 m (10 ft 6 in) more beam and 3.2 m (10 ft 6 in) less draught than the 23 m×7.6 m (75 ft 6 in×25 ft) of her sisters, she made only 22.49 knots on trial. The *Defence* and *Minotaur* just made their design speed of 23 knots, achieving 22.9 and 23.01 knots respectively. In 1909, all three had their funnels raised by 4.6 m (15 ft) which improved the draught to the boilers, but the extra power did not materially affect their speed.

The *Minotaur* and *Shannon* served with the Grand Fleet throughout the First World War, both took part in the Battle of Jutland and, during 1918-19, the *Shannon* was employed on Atlantic convoy escort duties. The *Defence* operated in the Mediterranean until early 1915, when she became the flagship of the 1st Cruiser Squadron with the Grand Fleet. At Jutland, on May 31, 1916, she was stationed about 8 km (5 miles) ahead of the Battle Fleet when she sighted and gave chase to German light cruiser forces. At 18.05 hrs she opened fire on the already crippled cruiser *Wiesbaden* and brought her to a stop with the second salvo. As she approached the enemy ship, she was engaged by units of the German battle fleet. Before she could escape she was straddled by two salvos in quick succession probably fired by the battleship *Friedrich Der Grosse*, receiving at least one hit from each. The second hit detonated her forward magazines and at 18.20 hrs she disappeared in a column of smoke and flame and sank. There were 901 losses, including Rear Admiral Sir Robert Arbuthnot and four civilians.

During 1914-15, all three ships had their topmasts cut down, the bridgework modified, torpedo-net defence removed and one 6-pdr and one 3-pdr AA gun fitted. In 1917, the *Shannon* and *Minotaur* had their foremasts converted to tripods and a director fitted on a platform below the foretop. They were also fitted with rangefinder baffles on the funnels for a short period and in 1918 both were painted in dazzle camouflage. By the end of the war the AA armament had been modified to one 3-in (76-mm) and two 3-pdr (2×1) guns. The *Minotaur* was sold for scrap in 1920, and the *Shannon* in 1922.

Displacement: 14 600 tons (Navy list), 16 100 tons (full load) *Length:* 168.19 m (519 ft) *Beam:* 22.71 m (74 ft 6 in) *Draught:* 7.92 m (26 f *Machinery:* 2-shaft triple expansion steam engines, 27 000 ihp=23 knots *Protection:* 152 mm (6-in) sides, 203-mm (8-in) gun positions, 3 mm (1½ in) decks *Armament:* 4 9.2-in (234-mm (2×2); 10 7.5-in (190-mm) (10×1); 16 12-pd (16×1); 5 46-cm (18-in) torpedo tubes (sub merged) *Crew:* 755

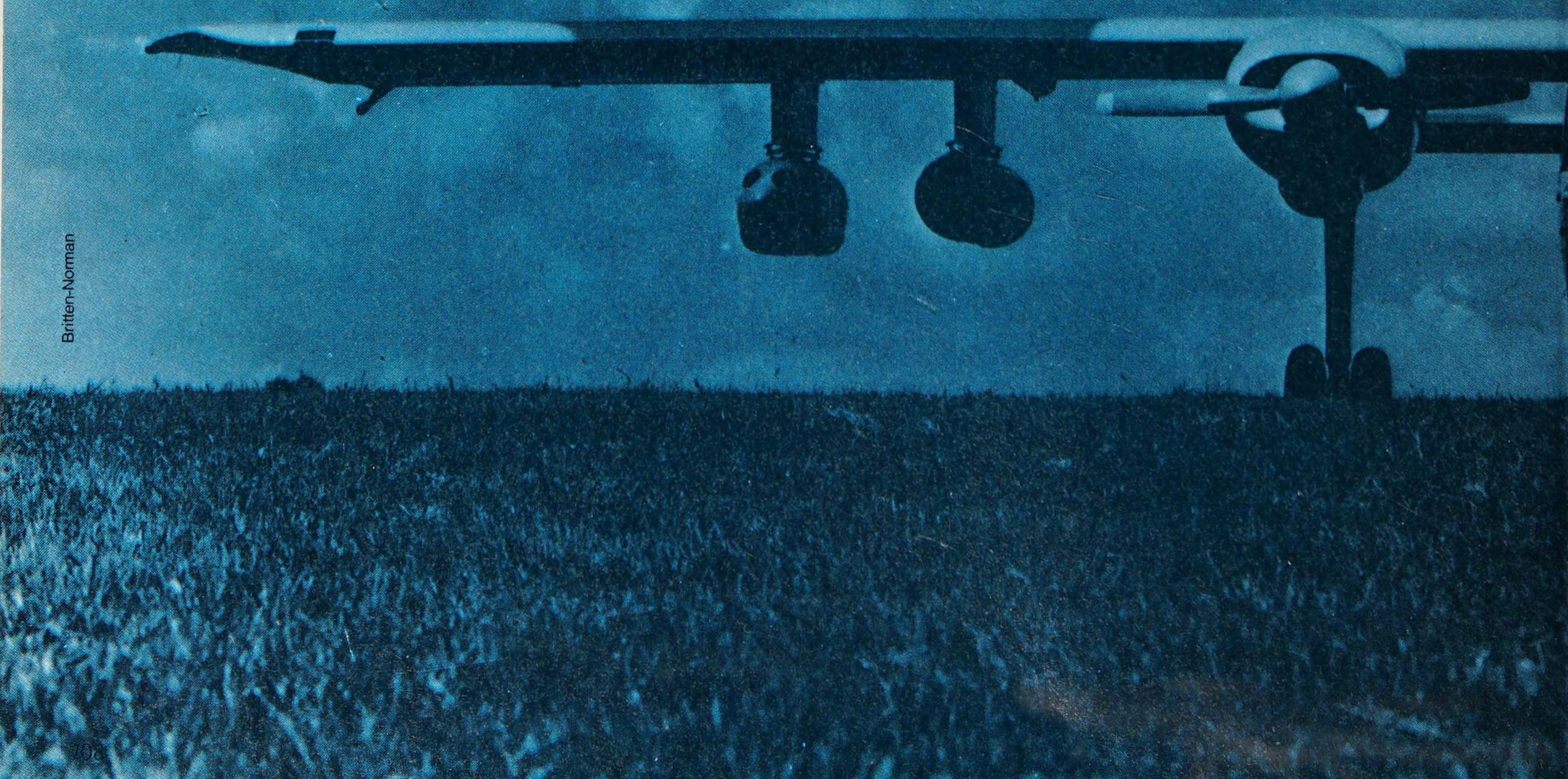
Defender

British destroyer class. The *Defender*, or 'D Class, flotilla were constructed under th 1930 Programme, all eight being launched i 1932. Their design was a repeat of that of th previous flotilla, the *Crusader* Class, excep that provision was made for a standard typ bridge, a heavier depth charge armament, single 3-in (76-mm) AA gun and two quad ruple 0.5-in (12.7-mm) machine-gun mount ings. The latter were mounted in the bridg wings and replaced the single 2-pdr pom poms mounted between the funnels in earlie vessels.

However, the new weapon was in shor supply and initially the *Daring*, *Defender Diamond* and *Diana* carried two single 2-pdrs instead. On completion they commis sioned for service in the Mediterranean.

During the first two years of the Second World War no less than seven of the eigh ships of the class were lost. The first to go was *Duchess* which collided with the battle ship *Barham* off the Mull of Kintyre on December 12, 1939.

The ship was struck abreast the forecastle causing her to capsize and blow up, 122 of her crew were lost and 23 saved. The *Daring* was torpedoed by the submarine *U 23* and sank off Duncansby Head on February 18, 1940, while on convoy escort duty. On July 29, 1940, the *Delight* was sunk off Portland by German aircraft.

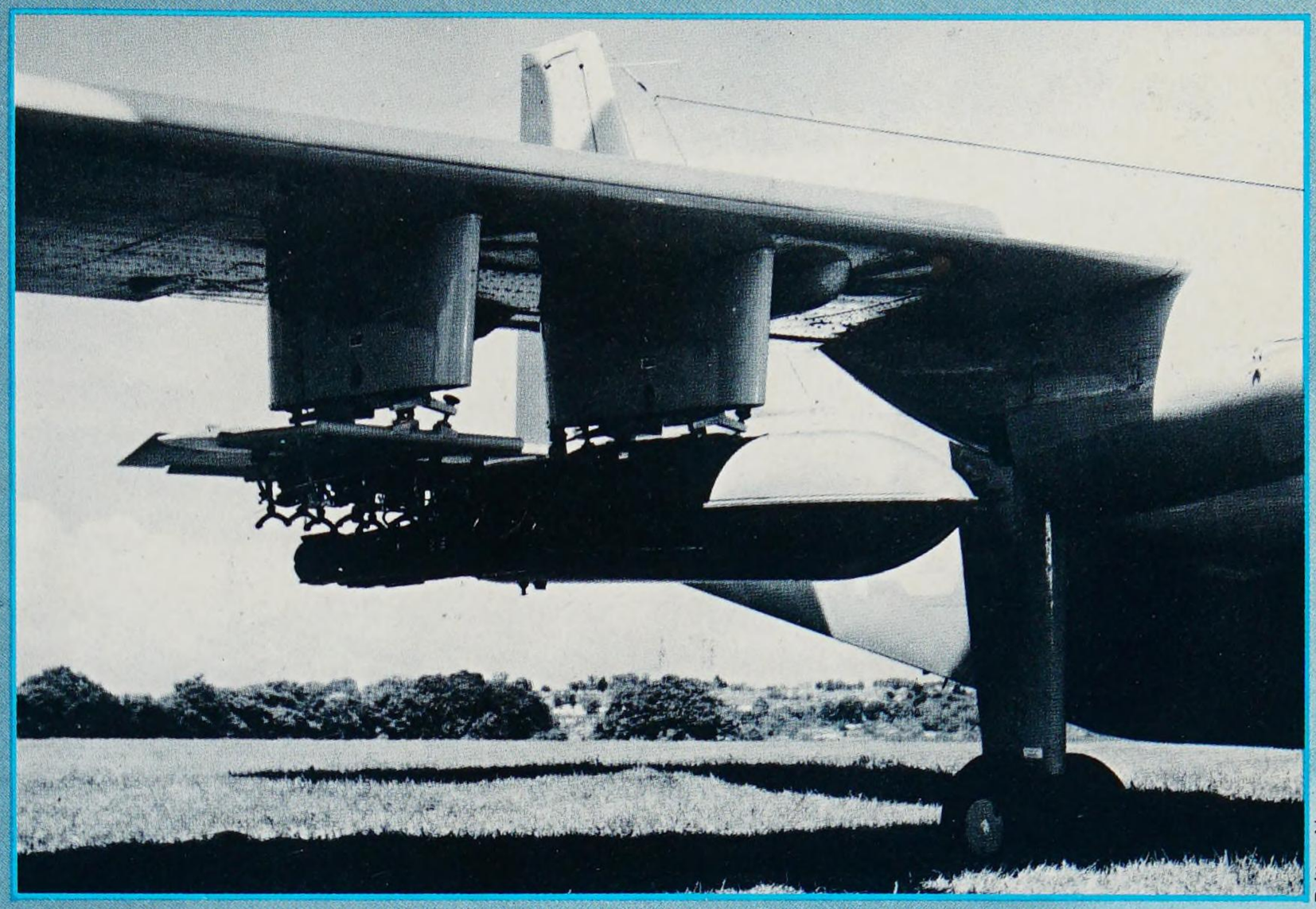


Britten-Norman

The *Diana*, transferred to the Royal Canadian Navy and renamed *Margaree*, was lost in collision with the merchantman *Port Fairy* on October 22, 1940, while escorting a convoy in the North Atlantic. The *Dainty*, with the destroyer *Ilex*, sank the Italian submarine *Liuzzi* in June 1940, but on February 24, 1941, was herself sunk by German aircraft off Tobruk Harbour. The *Diamond* was sunk in the same manner south of Morea on April 27, 1941, while evacuating troops from Nauplia; there were no survivors. The last to be lost was the *Defender* which was very badly damaged off Crete by a near-miss bomb. She was taken in tow but eventually had to be torpedoed by the destroyer *Vendetta*, and sank 11 km (7 miles) north of Sidi Barrani on July 11, 1941.

Due to so many early losses the ships received few modifications, but during 1940-41 several had their after bank of torpedo tubes replaced by a 12-pdr AA gun and, to give it a clear arc of fire, the after funnel was cut down by 2.1 m (7 ft) and the mainmast removed.

The one unit to survive the war, the *Decoy*, was however modified substantially. After serving in the Mediterranean during 1939-41 and with the Eastern Fleet during 1942, she was transferred to the Royal Canadian Navy in April 1943 and renamed *Kootenay*. She served as an escort vessel until 1945, for which purpose Y gun was removed to provide space for additional depth charge equipment while B gun was replaced by a Hedgehog antisubmarine weapon and two single 6-pdr guns. She was also fitted with 4 20-mm (0.79-in) (4×1) AA guns and the 0.5-in (12.7-mm) guns were removed. During July and August 1944 she assisted in the sinking of the German submarines *U678*, *U621*, and *U984* in the English Channel. She was sold for scrap in 1946.



Britten-Norman

A Defender with underwing pylons fitted with a 50-gal drop tank and two 5-in (127-mm) flares

Dainty, *Delight*—built by Fairfield
Daring, *Decoy* (later Canadian *Kootenay*)—built by Thornycroft
Defender, *Diamond*—built by Vickers Armstrong
Diana, *Duchess*—built by Palmers

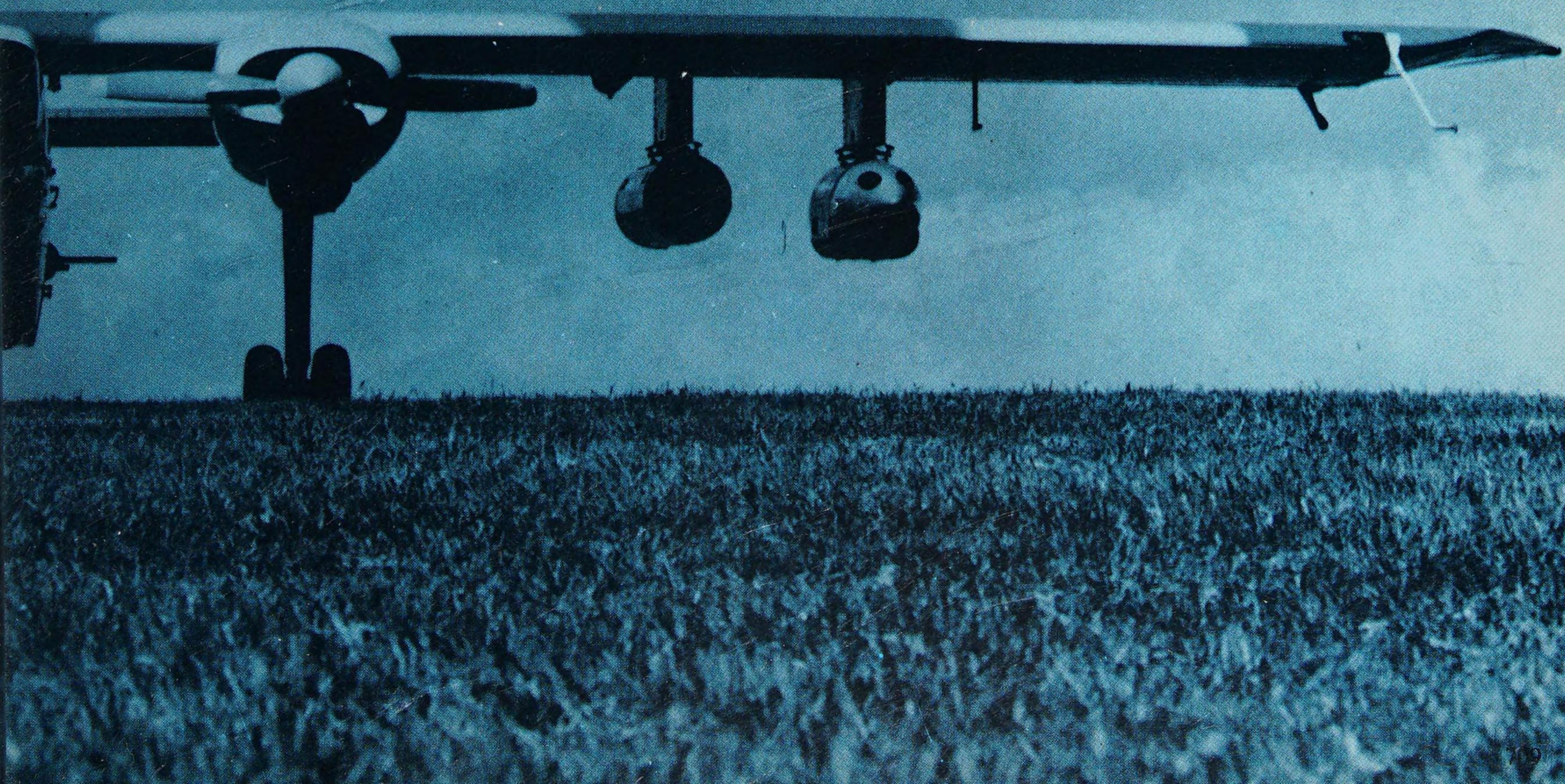
Displacement: 1375 tons (standard), 1890 tons (full load) *Length:* 100 m (329 ft) *Beam:* 10 m (33 ft) *Draught:* 2.5 m (8 ft 6 in) *Machinery:* 2-shaft geared steam turbines, 36 000 shp=35.5 knots *Armament:* 4 4.7-in (120-mm) (4×1); 1 3-in (76-mm) AA; 8 0.5-in (12.7 mm) (2×4); 8 53-cm (21-in) torpedo tubes (2×4) *Crew:* 145

Defender, Britten-Norman

British light utility transport. The Defender was a multi-purpose military development of Britten-Norman's ubiquitous Islander civil light transport. It made its first public appearance at the 1971 Paris Air Show and has since been sold to the armed forces of at least 17 countries and is in government use in several more.

With increased operating weights compared with those of the civil aircraft, the standard Defender engines are 300-hp Lycoming 10-540s with fuel injection. Most

A Britten-Norman Defender fitted with a Portsmouth Aviation gun-pod containing twin 7.62-mm (0.30-in) FN machine-guns, and the Matra T155 rocket launcher on the inner pylons with 18 Sneb unguided missiles per pod. The Defender can also be fitted with four machine-guns as a gunship



Defender, Model 500D-M Hughes

The Britten-Norman Defender is equipped not only for ground attack missions but also with drop-tanks on underwing pylons which makes it an effective maritime search aircraft. With visual observers and search radar it can cover an area of 114 000 sq km (44 000 sq miles) and carry rafts and rescue equipment. These facilities make it a useful aircraft for fishery protection and for patrolling off-sea oil rigs and shipping. The Maritime Defender developed for this role carries Bendix 1300 search radar

A TOW (tube-launched, optically-tracked, wire-guided) antitank missile is launched from a Hughes Model 500D-M Defender helicopter during trials

aircraft structure is unchanged from the civil version although a basic weapon system consists of four underwing pylons, a cockpit control panel, the necessary wiring, switches and weapons sights. Furthermore, extra fuel tanks can be carried on the inboard wing pylons.

The exact configuration of the aircraft clearly depends on the role in which it is used, such as search and rescue, forward air control, casualty evacuation or counter-insurgency light attack. Typical underwing loads, however, are twin light machine-guns in pods, flares, rockets or bombs. There is room inside for up to three stretchers and two attendants, or, for more offensive purposes, four sideways-firing machine-guns can be fitted to floor-support attachment points.

From the early days of the Defender it was thought to be particularly suitable for patrol and, in particular, maritime reconnaissance duties. With the emergence of more and more 322-km (200-mile) territorial and fishing limits, emphasis on this role has grown and resulted in the Maritime Defender, equipped with a Bendix 1300 search radar in the nose.

Span: 16.15 m (53 ft) *Length:* 10.84 m (35 ft 7 in) *Maximum takeoff weight:* 2994 kg (6600 lb) *Maximum speed:* 283 km/h (176 mph) clean, 270 km/h (168 mph) with pylons loaded *Maximum range:* 2771 km (1722 miles) with auxiliary fuel

Defender, Model 500D-M Hughes

US light antiarmour helicopter. Defender is the name chosen by Hughes for a special armed version of its Model 500 helicopter which carries the US Army designation of OH-6 Cayuse.

Development was carried out almost entirely because of overseas demand for an offensive helicopter which was neither as large nor as expensive as any of the specialized aircraft like the Bell AH-1 Huey Cobra or the new Hughes AH-64 Advanced Attack Helicopter. It is based on the civil Model 500D which carries seven people.

The principal difference between the Defender and previous military models of the basic type is that it is equipped to carry up to four TOW (Tube-launched, Optically tracked, Wire-guided) missiles on beams which extend from the side of the fuselage, giving it the ability to take on armoured targets on the ground as well as soft-skinned vehicles and installations. The sight for the gunner is mounted inelegantly, but effectively, in the nose, there being the standard TOW provision for laser tracking if the customer wishes to add it at a later date.

The Model 500D is virtually the same in fuselage size as the 500C but is powered by the 420-hp Allison 250-C20B engine. Hughes also decided to seek greater stability with this model, both at high and low speed, and better handling characteristics in the manoeuvring flight normally associated with low-level tactical roles. This has been achieved by modifying the tail to a T-configuration with small moving surfaces.

The main customer for the Defender is likely to be South Korea, which in 1976 signed a licence agreement with Hughes for the construction of about 100.

Rotor diameter: 8.05 m (26 ft 5 in) *Length overall:* 9.30 m (30 ft 6 in) *Maximum takeoff weight:* 1360 kg (2998 lb) *Maximum speed:* 282 km/h (175 mph) *Maximum range:* 540 km (335 miles)

Defender, FD-25 Fletcher/Toyo

US/Japanese light ground-support aircraft. It became fashionable, in the late 1960s and 1970s, for manufacturers, usually at the request of Third World customers, to modify their light primary trainers to carry rockets, flares, small bombs and even light antitank missiles. The American company Fletcher Aviation, however, in many ways jumped the gun in the mid-1950s by designing the FD-25 Defender, a single-seater of only 560 kg (1230 lb) empty weight and powered by a 225-hp Continental E225-8 piston engine.

Fletcher had become known for plastic-plywood construction and for symmetrical flying and control surfaces which were thus interchangeable. The FD-25, though of all-metal construction and with cranked wings (6° of dihedral on the outer sections), illustrated the influence of its predecessors with interchangeable ailerons. The type had a steerable tail wheel and stalky, fixed main undercarriage legs. Designed specifically for light ground support, the Defender even went as far as to have two 30-cal machine-guns, each with 1000 rounds, mounted internally in the wings. In addition there were four weapon pylons under each wing capable of carrying rockets, 181-litre (40-Imperial gal) napalm tanks, or two 250-lb (113-kg) bombs.

After initial development in the US, a

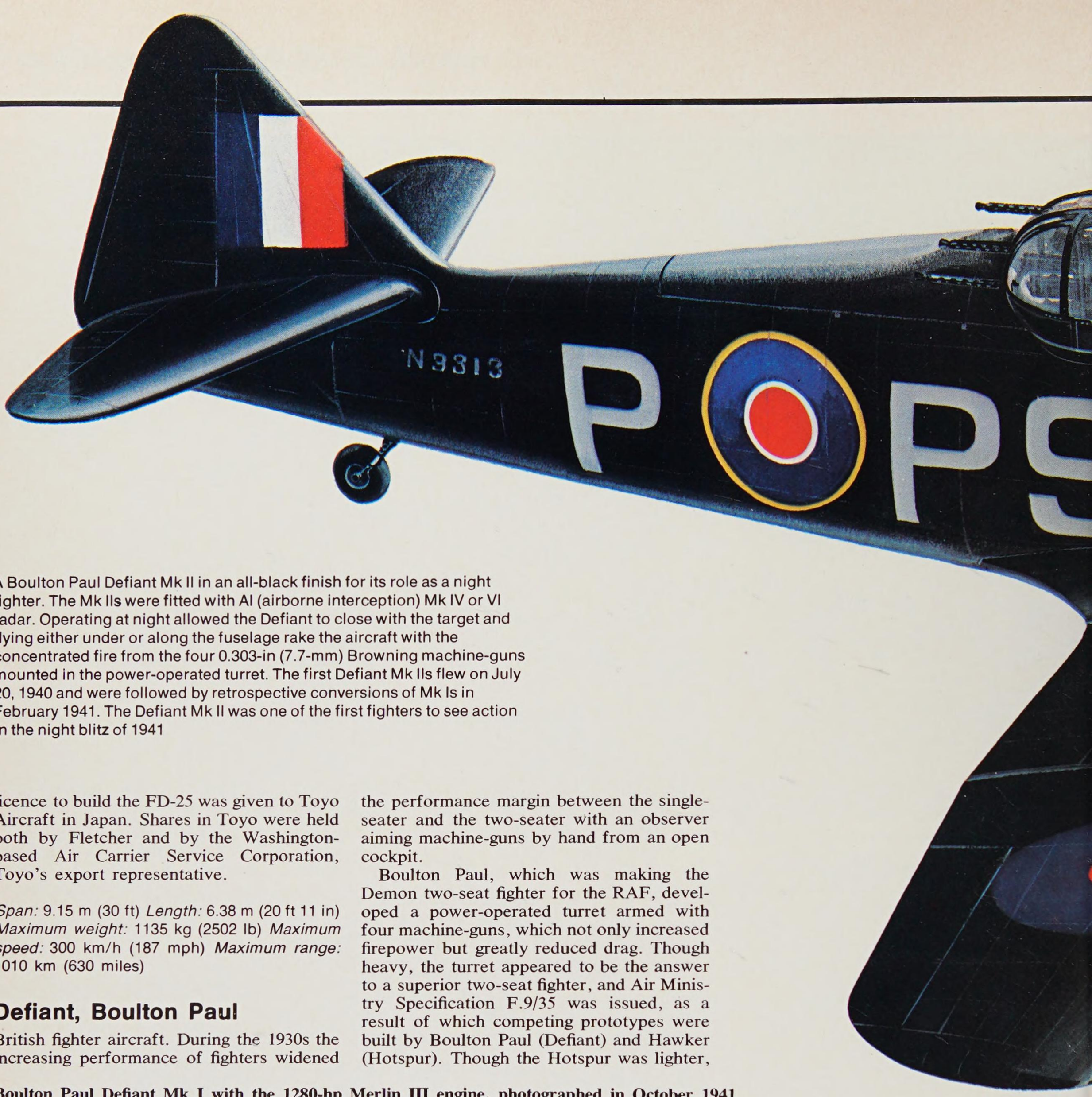
licence to build the FD-25 was given to Toyo Aircraft in Japan. Shares in Toyo were held both by Fletcher and by the Washington-based Air Carrier Service Corporation, Toyo's export representative.

Span: 9.15 m (30 ft) *Length:* 6.38 m (20 ft 11 in) *Maximum weight:* 1135 kg (2502 lb) *Maximum speed:* 300 km/h (187 mph) *Maximum range:* 1010 km (630 miles)

Defiant, Boulton Paul

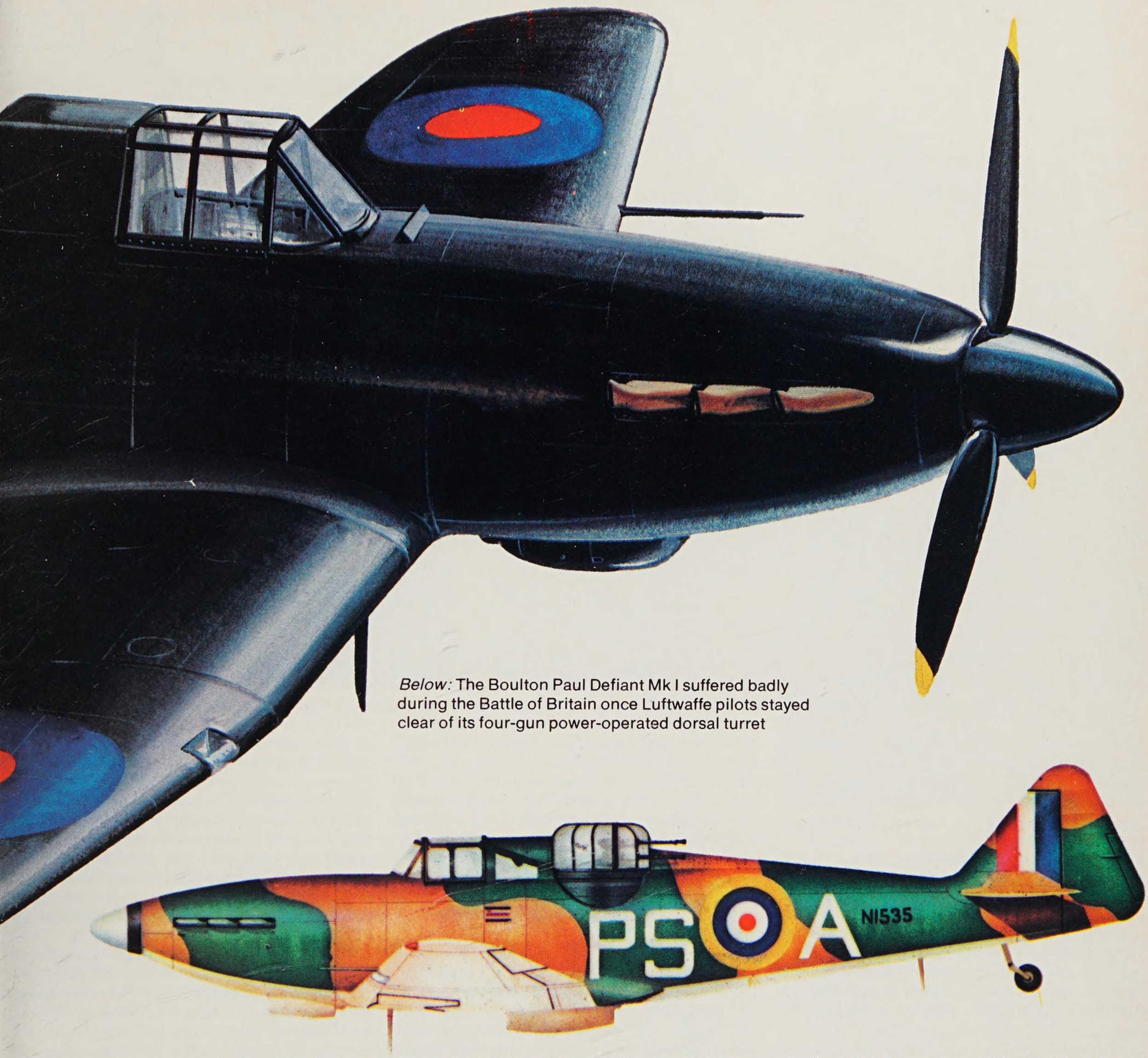
British fighter aircraft. During the 1930s the increasing performance of fighters widened the performance margin between the single-seater and the two-seater with an observer aiming machine-guns by hand from an open cockpit.

Boulton Paul, which was making the Demon two-seat fighter for the RAF, developed a power-operated turret armed with four machine-guns, which not only increased firepower but greatly reduced drag. Though heavy, the turret appeared to be the answer to a superior two-seat fighter, and Air Ministry Specification F.9/35 was issued, as a result of which competing prototypes were built by Boulton Paul (Defiant) and Hawker (Hotspur). Though the Hotspur was lighter,



A Boulton Paul Defiant Mk II in an all-black finish for its role as a night fighter. The Mk IIs were fitted with AI (airborne interception) Mk IV or VI radar. Operating at night allowed the Defiant to close with the target and flying either under or along the fuselage rake the aircraft with the concentrated fire from the four 0.303-in (7.7-mm) Browning machine-guns mounted in the power-operated turret. The first Defiant Mk IIs flew on July 20, 1940 and were followed by retrospective conversions of Mk Is in February 1941. The Defiant Mk II was one of the first fighters to see action in the night blitz of 1941

Boulton Paul Defiant Mk I with the 1280-hp Merlin III engine, photographed in October 1941



Below: The Boulton Paul Defiant Mk I suffered badly during the Battle of Britain once Luftwaffe pilots stayed clear of its four-gun power-operated dorsal turret

faster and more manoeuvrable, Hawker and Avro (which would have made it) were over-committed; Boulton Paul, however, needed the Defiant programme, so the more sluggish machine was ordered.

First flown without turret in August 1937, the Defiant had no wing guns and, as it had a smaller wing than a Hurricane yet weighed much more, the manoeuvrability was poor. The Type A Mk IID turret had four 0.303-in (7.7-mm) Brownings, with 600 rds/gun, with hydraulic aiming by a joystick with firing button. Rotation, by left/right stick movement, worked pneumatic rams which raised or lowered wooden fairings in front and behind. Deliveries began in December 1939, and two flights of 264 Squadron became operational in late March 1940.

At first the philosophy of the turret-armed fighter seemed justified, because in the last four days of May the squadron claimed 57 victories. Later it was discovered that a more likely figure was 13; but, at the time, the exaggerated score was believed, and turret fighters were given high priority. Versions of the Mosquito and Beaufighter were backed up by a number of specifications for specially developed twin-engined machines with turrets mouting up to four 20-mm (0.79-in) cannon. Boulton Paul made the P.92 research prototype intended to underpin one of these aircraft.

In fact, the whole concept was a major mistake. By the end of August 1940, the only two operational units, 264 and 141 Squadrons, had been so mauled as to be withdrawn. The Defiant was quite useless in day combat. It never again operated in its design role in daylight, but production of 930 was in full spate and the only answer was to use it as a night fighter. Eventually 13 squadrons were equipped with the Defiant I, with flame-damped exhaust; the IA with AI Mk V or VI interception radar; or the Mk II with the 1030-hp Merlin replaced by the 1280-hp Merlin XX and speed increased from 480 to 508 km/h (298-316 mph), with additional fuel capacity. In the night-fighter role, armed with radar from September 1941, at least the Defiant could survive, but it was less effective than either the Beaufighter or the unaided Hurricane and Spitfire operating with pilot only and without radar.

The type was withdrawn from combat duty in 1942, and a few were used for air/sea rescue missions, despite their poor turning circle and high stalling speed. Only about 60 aircraft were converted to ASR.I configuration, with large underwing containers for two M-type dinghies with survival gear. By the end of 1942 nearly all survivors had undergone conversion to operate as target tugs, except for the final 140 of the total production of 1060 aircraft which were ordered as Defiant TT.II tugs from the start.

Altogether, nearly 350 Defiants were built or converted for use as target tugs. The latter, the TT.I (ex-Mk II fighter of new build with Merlin XX) and TT.III (rebuilt Mk I

A Defiant Mk II night fighter in August 1941, with part of the AI radar antennae visible on the outer edge of the starboard wing

with Merlin III), had the turret replaced by a comfortable aft-facing cockpit for the winch operator, with frameless canopy, the winch itself being driven by a windmill on the right side and governing the run-out of either of two sleeve targets housed in a large box faired under the rear fuselage. About 60 TT Defiants served with the Royal Navy.

Though the Defiant continued in TT service to the end of the Second World War, its greatest accomplishment was with 100 Group in 1943-44 carrying Mandrel radar jammers, one of the first-ever active ECM systems, which operated on the exact wavelength of the Freya and other German defence electronics. On D-Day, June 6, 1944, Defiants participated in the simulation of a large invasion fleet across the Pas de Calais, flying rectangular patterns whilst strewing Window passive ECM. Basically a good aircraft, the Defiant was crippled as a fighter by its faulty underlying concept.

Span: 11.99 m (39 ft 4 in) *Length:* 10.77 m (35 ft 4 in) *Gross weight:* 3900 kg (8600 lb) *Maximum speed:* 507 km/h (315 mph)

De Grasse

French antiaircraft cruiser. Three improved *La Galissoniere* Class light cruisers were ordered for the French navy prior to the Second World War, but only one, *De Grasse*, had actually been laid down before the outbreak of hostilities. The other two, *Chateaurenault* and *Guichen*, were cancelled.

The *La Galissonieres* were a successful design, and the *De Grasse* Class were to have followed the same general layout, with three triple 6-in (152-mm)/50-cal turrets, three twin 3.5-in (90-mm), five single 25-mm (1-in), eight 13.2-mm (0.52-in), and two triple 21.7-in (55-cm) torpedo tubes. They were to have two rather than one catapult, for Loire Nieuport 130 seaplanes, similar protection and the slightly higher speed of 35 knots. The major difference was that whereas the *La Galissoniere* Class had two funnels and a relatively low bridge, the *De Grasse* Class were to have a large single funnel and a tall piled-up bridge.

De Grasse was ordered under the 1937 Estimates and was laid down in November 1938 at Lorient dockyard. Work continued on her until May 1940, by which time her hull was quite well advanced. Work was suspended during the German occupation, but it was restarted in 1946 and the hull was launched on September 11 of that year to clear the slip. Work was then once again suspended whilst the French navy decided what to do with her. The original design was obsolete, France had a number of gun-armed cruisers that had survived the war and it was already obvious that aircraft were a more important threat than surface vessels.

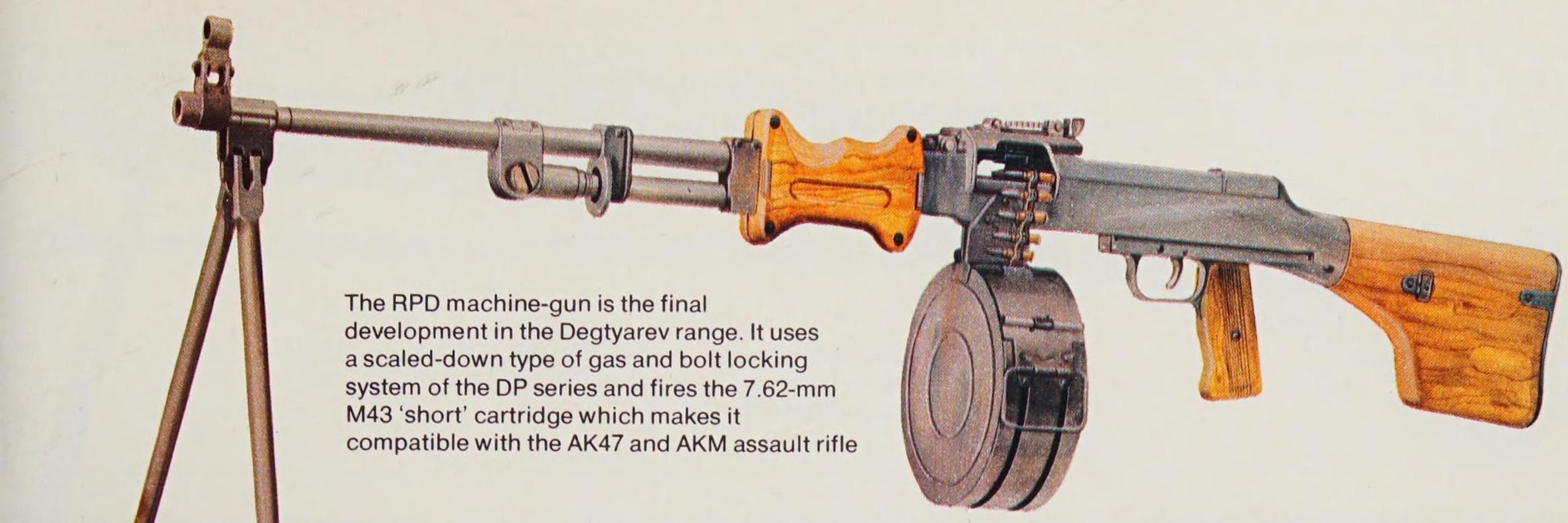
Work was therefore recommenced on *De Grasse* on January 19, 1951 to complete her as an all-gun armed antiaircraft cruiser. Although the US was beginning to convert some of her cruisers to missile-armed vessels, France lacked the technology and in any case the French did not consider that missiles were as yet developed sufficiently to be a ship's main armament.

De Grasse was completed at Brest dockyard, and was commissioned on September 3, 1956. Her main armament of eight twin 5-in (127-mm) mounts was arranged symmetrically, with two turrets forward, two aft, and two on either side of the superstructure fore and aft. Her secondary armament of six twin 57-mm (2.24-in) mounts was grouped round the superstructure at a higher level. She was comprehensively equipped with radar and was intended to act as a fleet flagship and to control air strikes and the air defence of the fleet. When she was completed she was a powerful and effective AA vessel, well equipped to operate with the French light carrier force.

However, new AA missiles were developed which could provide a reliable defence at much longer ranges than *De Grasse*'s guns. *Colbert*, whose design had been developed from that of *De Grasse*, had been built with the idea of fitting missiles at a later stage, but *De Grasse* herself was too thoroughly compartmented for it to be easy or cost effective to fit a missile system with its large magazine into her hull. In 1966, therefore, she was refitted at Brest to act as the flagship of the French Pacific Experimental Nuclear Centre.

The aft 5-in (127-mm) and the 57-mm (2.24-in) mounts were removed, the bridge was enlarged, and a large lattice mast and radars were added aft. Extra accommodation was fitted and the communication facilities were increased. She served in this role for a number of years, and was also used in the periods between the tests as a fleet flagship for operations in the French colonies. She was discarded in 1973.

Displacement: 9000 tons (standard), 12 350 tons (full load) *Length:* 188.3 m (617 ft 9 in) oa *Beam:* 21.3 m (69 ft 10½ in) *Draught:* 6.5 m (21 ft 4 in) *Machinery:* 2-shaft geared steam turbines, 105 000 shp=33 knots *Protection:* 102 mm (4 in) sides; 76 mm (3 in) deck *Crew:* 560



The RPD machine-gun is the final development in the Degtyarev range. It uses a scaled-down type of gas and bolt locking system of the DP series and fires the 7.62-mm M43 'short' cartridge which makes it compatible with the AK47 and AKM assault rifle

Degtyarev

Soviet light machine-guns. When the Red Army was formed in the early 1920s, one of its pressing needs was for a light machine-gun. This was finally produced in the newly-formed design office in the Kovrov Machine-gun factory to the design of Vasiliy Alexeyevich Degtyarev, one of the great names in weapon design. His model was first tested in 1926 and finally adopted in 1928. The Russian name for it was *Pulomet Degtyareva Pekhotnii*, or DP, and it served continuously in the Soviet Army until the 1950s.

The DP was a triumph of simplicity. It had only six moving parts in the mechanism with a consequent gain in reliability and strength over many other ideas current at that time, though it must be said that this simplicity also brought some troubles. One was that there were rather large flat surfaces which had to work together, and there was more friction than was desirable. In very cold weather, when the lubrication stiffened up, the DP required considerable power, and Degtyarev gave it a widely variable gas regulator to adjust to varying weather conditions.

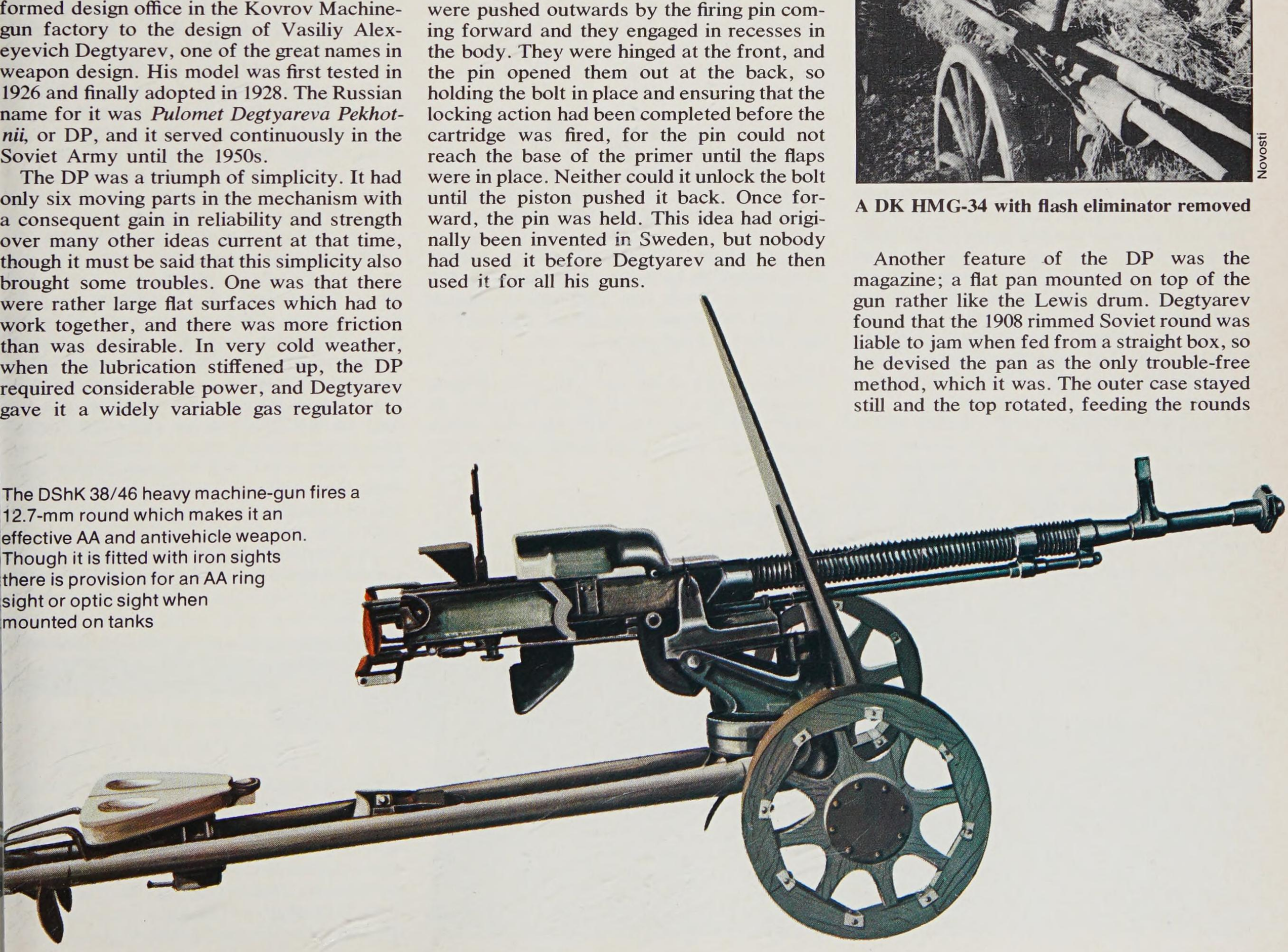
The general system of operation was by gas, using the long-stroke principle, with a few innovations specifically put in to ease the manufacture. The main methods of making it were by machining from the solid, as were all other guns at that time, but Degtyarev went to a lot of trouble to reduce all the machining to the minimum, and as a result he produced a machine-gun which was one of the cheapest and easiest to make.

One particular feature was the locking system, which utilized a pair of locking flaps, one on either side of the bolt. These flaps were pushed outwards by the firing pin coming forward and they engaged in recesses in the body. They were hinged at the front, and the pin opened them out at the back, so holding the bolt in place and ensuring that the locking action had been completed before the cartridge was fired, for the pin could not reach the base of the primer until the flaps were in place. Neither could it unlock the bolt until the piston pushed it back. Once forward, the pin was held. This idea had originally been invented in Sweden, but nobody had used it before Degtyarev and he then used it for all his guns.

Novosti

A DK HMG-34 with flash eliminator removed

Another feature of the DP was the magazine; a flat pan mounted on top of the gun rather like the Lewis drum. Degtyarev found that the 1908 rimmed Soviet round was liable to jam when fed from a straight box, so he devised the pan as the only trouble-free method, which it was. The outer case stayed still and the top rotated, feeding the rounds



The DShK 38/46 heavy machine-gun fires a 12.7-mm round which makes it an effective AA and antivehicle weapon. Though it is fitted with iron sights there is provision for an AA ring sight or optic sight when mounted on tanks

The DPM light machine-gun. Like the DTM, it had a bigger drum magazine and was mounted in wartime tanks until superseded by the DShK

one at a time to the feed slot where they were stripped out by the bolt. Forty-seven rounds were carried in this way, but the loading was rather complicated and took time. The number two of the gun team carried three full magazines in a steel case, which was a heavy and awkward load.

This excellent gun fought through the minor actions in Manchuria and Spain and even the 1939 Winter War brought no changes to the design. In fact, the only alteration ever made was in 1944, when the recoil spring was removed from its original place under the barrel and housed in a separate tube behind the bolt. It got too hot under the barrel and there were complaints of it losing its temper and strength. In the new position it stuck out to the rear and looked ugly, and the firer had to be given a pistol grip as he could no longer get his hand around the butt.

Although intended as an infantry gun only, the DP was slightly modified and issued for armoured vehicles and aircraft. It was not well suited to these tasks, but the shortages in Russia were too great for anyone to be fussy. The tank version, the DT, removed the butt, fitted a heavier barrel and a 60-round magazine in two layers. Some were taken back into infantry use late in the war, which confuses the recognition of them. For the aircraft DA version, the same large magazine was used and the rate of fire was stepped up to the limit, about 800 rds/min, but it was a poor substitute for a proper air gun.

Finally, there was a 1946 version with a heavier barrel and a belt-feed issued as a 'company' gun for support fire for the platoons. Despite the belt-feed, the flat magazine could be fitted if required. All versions were phased out of service in the 1950s.

The Degtyarev mechanism was also used in the DShK 1938 12.7-mm (0.5-in) heavy machine-gun. Degtyarev had laid out the general design for the gun in 1934 and Georg S Shpagin produced the feed mechanism. It was a belt-fed gun which weighed 35.5 kg (78 lb 8 oz) and was consequently either mounted in armoured vehicles, on AA tripods or the old Maxim 'Sokolov' wheeled carriage. The heavy round made it an effective AA gun in the Second World War, and later in Korea and Vietnam.

Another machine-gun from the Degtyarev family which was used effectively in both Vietnam and the Middle East is the RPD. The Ruchnoi Pulemet Degtyarev is a belt-fed 7.62-mm (0.30-in) gun firing the intermediate round compatible with the AK rifle. The magazine is a detachable drum holding 100 rounds which is clipped beneath the gun at the centre of gravity.

(DP) *Length:* 1290 mm (50.8 in) *Weight:* (unloaded) 9.12 kg (20.1 lb) *Magazine:* 47-round flat drum *Cyclic rate:* 500-600 rds/min *Muzzle velocity:* 840 m/sec (2756 ft/sec) *Calibre:* 7.62 mm (0.3 in) (1908 pattern)

(RPD) *Length:* 1041 mm (41.00 in) *Weight:* (unloaded) 7.00 kg (15 lb 7 oz) *Magazine:* 100 round belt *Cyclic rate:* 700 rds/min *Muzzle velocity:* 734 m/sec (2408 ft/sec) *Calibre:* 7.62 mm (0.26 in) (1908 pattern)

(DShK) *Length:* 1586 mm (62.4 in) *Weight:* (unloaded) 35.5 kg (78 lb 4 oz) *Magazine:* 50 round belt *Cyclic rate:* 550 rds/min *Muzzle velocity:* 860 m/sec (2822 ft/sec) *Calibre:* 12.7 mm (0.5 in)

Degtyarev

Soviet submachine-guns. The Red Army started experimenting with submachine-guns in 1926, but made little progress until Degtyarev produced his first model in 1933. This was taken into service as the 1934 model, though not many were actually made. It was obviously inspired by the Schmeisser-designed MP 28 and Finnish Suomi, but the resulting weapon was both practical and sensible for its time.

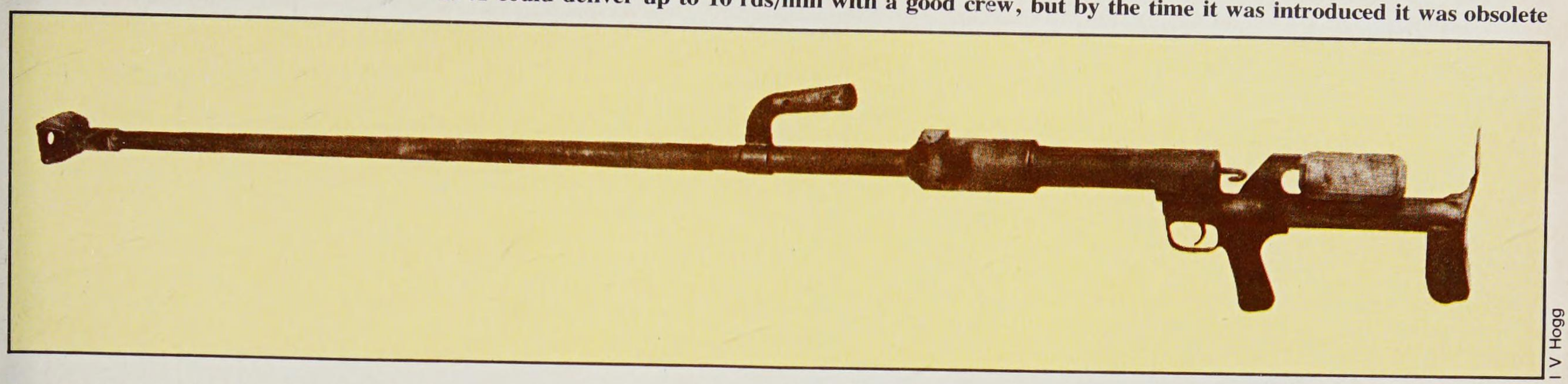
It was made by the conventional methods, with everything machined from the solid and using quite high quality steel. Most of the guns had chromed barrels, a most unusual feature at that time, and one which was to become a hallmark of Soviet weapons. The long one-piece wooden stock was very similar to that of the MP 28, as was the tubular barrel jackets and receiver with a milled cap on the end. Internally, it was also similar to the MP 28, and had the same moveable firing pin operated by a cam. There was much the same selector mechanism for single shots or automatic fire, but Degtyarev chose to use a rotating tab inside the trigger guard instead of the push-pin fitted by Schmeisser.

The whole feel of the Degtyarev was of a solid and satisfying weapon, one which was strong and could be relied on to work at all times. The only jarring note was struck by the magazine, which was unusual and looked frail. Degtyarev took the Suomi 71-round drum and used it without alteration, but he could not fit it to his gun as the wooden stock ran straight through. His original idea had been to fit a 25-round box. Whether this was ever done or not is not now known but it may have been tried and dropped during troop trials, for at 800 rds/min 25 rounds were fired off in less than two seconds, which really only gave two bursts.

The Suomi magazine was modified to take a short column so that it could be loaded into

A PPD 40 (Pistolet-Pulemet Degtyarev 1940, or Degtyarev machine pistol 1940) was first used in the Winter War against Finland in 1940. By the time Germany invaded Russia in 1941 it had been superseded by the PPSh which was quicker and cheaper to make. The PPD 40 had itself been developed as a less costly version of the PPD 34 but it was still fairly expensive

Below: The Degtyarev antitank rifle without its bipod support. The 14.5-mm (0.57-in) Degtyarev-PTRD 1941 could deliver up to 10 rds/min with a good crew, but by the time it was introduced it was obsolete



IWM

the existing housing. In other words, it had a short length of box magazine added on to it, which hung below the gun rather than being locked into it. The difference was small, but may have made the gun less strong than it should have been. There were continual minor modifications until 1938, when it remained as the Model 34/38 and was used as such in the Winter War with Finland.

It was then obvious to the Soviets that they would need to modernize their entire armoury. Degtyarev was told to simplify the submachine-gun to make it easier and quicker to manufacture. His first move was to standardize on the Suomi drum and forget about the smaller box altogether. Doing this allowed him to fit the drum direct on to the receiver and so do without the short column. The holder for the drum was made very strong, which makes one wonder if the older method had broken at times, and it is both pinned and brazed to the barrel jacket and receiver. The weight was still fairly high. In fact, it does not seem that Degtyarev was able to reduce the manufacturing time by very much, since the general construction is still largely from machined parts. All the barrels were now chromed, the first production weapon to be so treated.

The modified gun came into service in the spring of 1940, and was designated Model 40 or Model 1940. Quite large numbers were made, and mostly lost in the first German advances in 1941, and it was the difficulties of mass producing the gun that persuaded the Soviet authorities to drop the Model 1940 design and go over to a simpler design, the Shpagin designed PPSh-41.

These two designs were the only submachine-guns that Degtyarev produced, and they are not particularly inspired. He relied heavily on other designs and introduced few ideas of his own, but at least his guns worked and they were used in sufficient numbers to show the Soviet army what a submachine-gun could and should do. Many were still in use at the end of the war, but none were made after 1941.

Length: 787 mm (31 in) *Weight:* (unloaded): 3.70 kg (8 lb 2 oz) *Magazine:* 71-round drum *Cyclic rate:* 800 rds/min *Muzzle velocity:* 500 m/sec (1644 ft/sec) *Calibre:* 7.62 mm (0.3 in) Soviet pistol

Degtyarev

Soviet antitank rifle. In 1940 the Soviet army was without an antitank rifle, at a time when practically every other nation was well equipped with them. Furthermore, in the war with Finland, the Finns had used antitank rifles to good effect, and the lesson was not lost on the Soviets. After several unsuccessful efforts, Degtyarev was given the task of designing a rifle which would use the 14.5-mm (0.57-in) round from the heavy machine-gun.

Degtyarev aimed for simplicity and produced a remarkable single-shot rifle, which although very simple in its concept was remarkably ingenious in its application. He was forced to use a long barrel because of the ammunition, but he kept the weight down by producing almost a skeleton of a bolt system. The receiver or body of the gun was no more than a piece of tube welded to the breech; in this tube the bolt worked to and fro with slots cut out for the handle and the trigger, pistol grip and butt were on the slide. The barrel group recoiled along the slide, restrained by a short spring and so absorbed some of the recoil shock. As the bolt handle moved backwards, it struck a shaped plate and was knocked upwards; at the full point of rear movement it was held, and as the barrel group went forward again it automatically pulled out the cartridge case and ejected it. All the gunner then had to do was to feed another cartridge in and close the bolt.

This gun was issued to platoons for local defence, and although it was too weak against the German Mk III and IV tanks, it was good enough against light vehicles.

Length: 1996 mm (79 in) *Weight:* 17.7 kg (38 lb) *Magazine:* None, single shot *Muzzle velocity:* 1010 m/sec (3314 ft/sec) *Calibre:* 14.5 mm (0.57-in)

de Havilland British aircraft See **Hornet, Mosquito, Okapi, Oxford, Vampire, Venom**

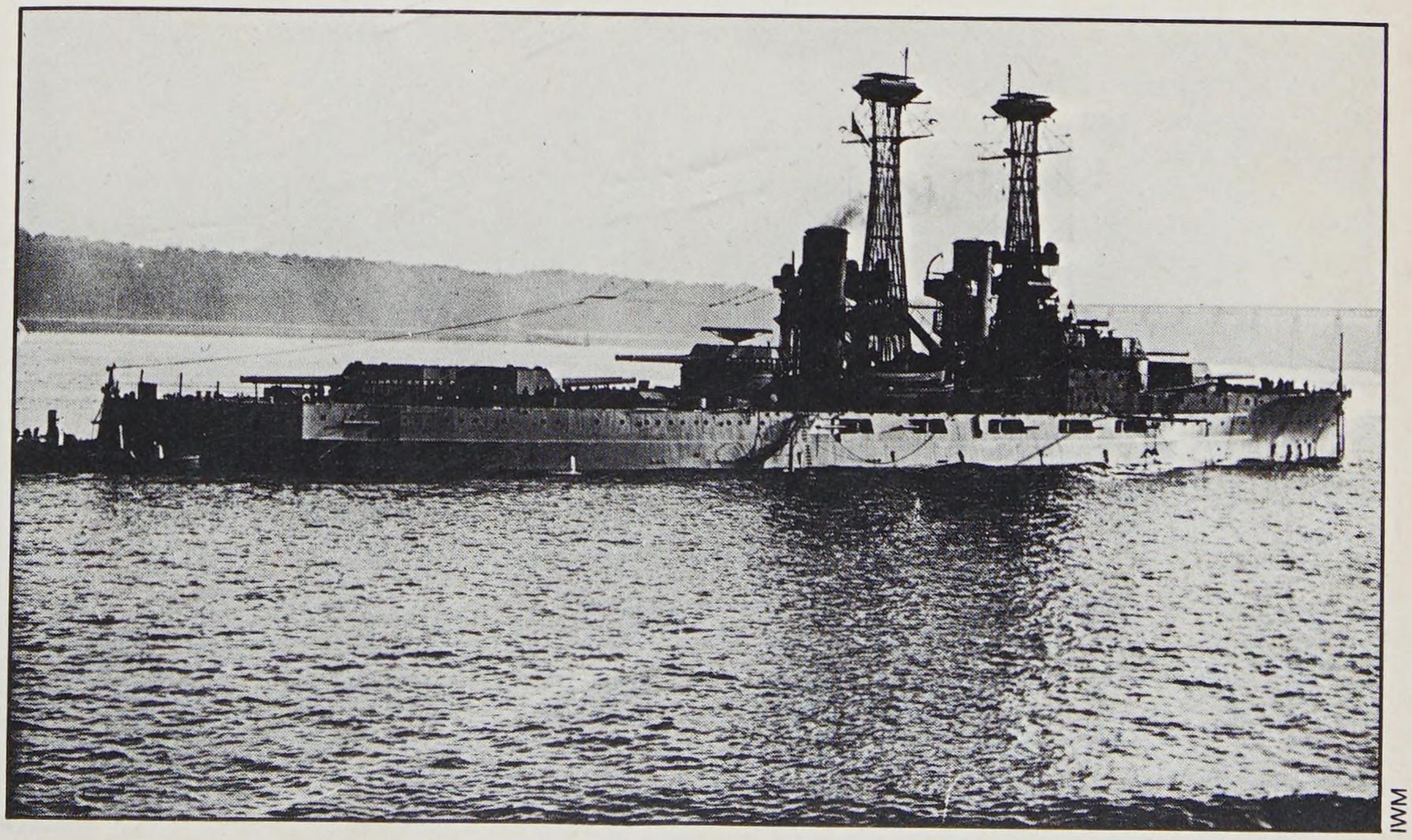
de Havilland Canada Canadian aircraft See **Beaver, Buffalo, Caribou**

Delaware

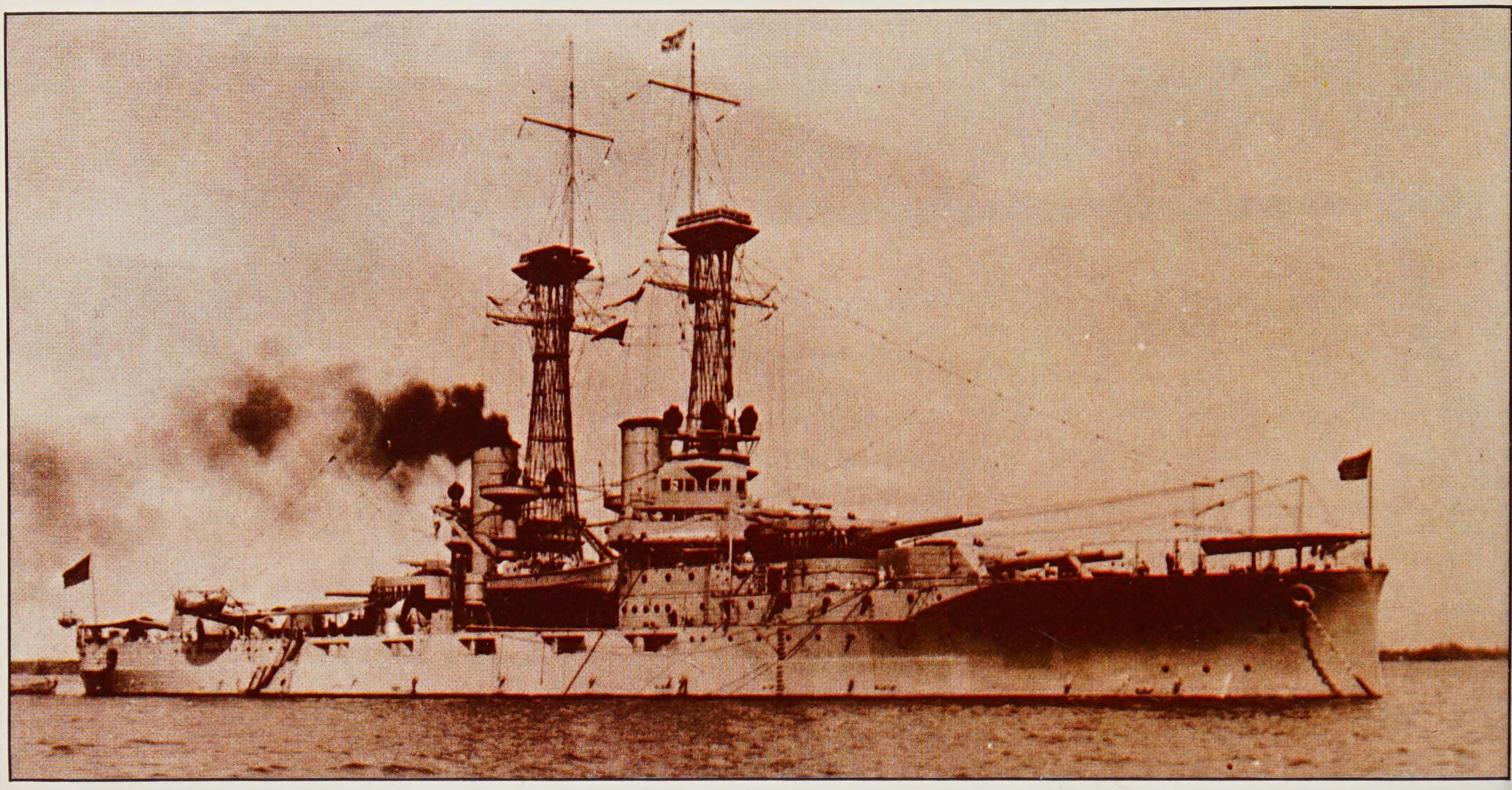
US battleship class, built 1907-10. In June 1906 and March 1907 Congress authorized the construction of two battleships, *Delaware* and *North Dakota* respectively. They were the second class of US Dreadnoughts and the first US ships to exceed the 20 000-ton limit. They were developments of the revolutionary *South Carolina* design, but to increase the weight of broadside the hull was made longer and an additional 12-in (305-mm) twin gun-mounting was installed aft. The secondary battery was considerably strengthened, with 5-in (127-mm) guns in place of the *South Carolina*'s 3-in (76-mm).

Considerable problems were encountered with the propulsion of these ships. Although the Bureau of Construction and Repair was anxious to keep up with the British in adopting steam turbines, US heavy industry was not able to meet the demand. The *Delaware* was given 2-shaft vertical triple-expansion

USS *Delaware* at Rosyth in 1918, where she was attached to the British Grand Fleet



IWM



USS *Delaware* at the US naval base at Guantanamo, Cuba, in January 1920. Note the AA guns on the derrick posts between the masts

Name and No	launched	builder
Delaware BB.28	2/1909	Newport News
North Dakota BB.29	11/1908	Fore River, Quincy

engines. Her sister had 2-shaft Curtis turbines, but in 1916-17 she had to be reengined with Parsons turbines. The back-to-back arrangement of the after 12-in (305-mm) guns was not ideal and the positioning of the 5-in (127-mm) guns meant that they were liable to be masked by spray in a seaway.

The *Delaware* served with the 6th Battle Squadron in the British Grand Fleet in 1917-18, but her sister remained on the east coast as a training ship for gunnery and engineering officers. Both served in a training capacity after the war, but were among the older 12-in (305-mm) gunned Dreadnoughts declared surplus to fleet requirements under the Washington Treaty, and were decommissioned in November 1923. The *North Dakota* was scrapped the following year, but her sister survived as a target until 1931.

In 1917-18 both ships underwent modifications, including the conversion of the old square spotting tops on the 'cage' masts into enclosed fire-control platforms.

Displacement: 20 380 tons (normal), 22 400 tons (full load) *Length:* 155.45 m (510 ft) wl *Beam:* 25.98 m (85 ft 3 in) *Draught:* 8.22 m (27 ft) *Machinery:* 2-shaft reciprocating/steam turbines, 25 000 ihp/shp=21 knots *Protection:* 229-280 mm (9-11 in) belt; 203-305 mm (8-12 in) turrets; 76 mm (3 in) decks; 305 mm (12 in) conning tower *Armament:* 10 12-in (305-mm)/45-cal (5×2); 14 5-in (127-mm)/50-cal (14×1); 2 3-in (76-mm), *added 1917* (2×1); 2 21-in (53-cm) torpedo tubes (beam, submerged) *Crew:* 933

Delfin

Norwegian torpedo boat class. Towards the end of the nineteenth century most of the navies of the world were building up their coastal defence forces by constructing flotillas of torpedo boats, for much the same reason as their successors are now buying missile-armed patrol boats. They offered a combination of cheapness and apparent effectiveness, particularly appropriate to the smaller navy. The vessels would normally be built by one of the four specialist builders of such craft, Yarrow and Thornycroft in Britain, Le Normand in France, or Schichau in Germany. The Scandinavian states, however, had rather better technical resources than most of the smaller navies, and tended to depart from this procedure by building a modified foreign design under licence.

In 1896 three two-funnelled 79-ton torpedo boats were launched by Schichau for Norway. These, the *Delfin, Hai* and *Hval,* were adaptions of a standard Schichau design which was proving particularly popular in export markets at the time. Two Thornycroft boilers provided steam for the single reciprocating engine, and they achieved 24½ knots trial speed, with 1000 hp. The boats seemed satisfactory, and three similar vessels were ordered from the main Norwegian warship building yard at Horten, near Oslo (then Christiania). These were the *Storm, Brand* and *Trods,* all launched in 1899.

The end of the nineteenth century was a period of tension between Norway and Sweden and before being granted independence from Sweden, Norway ordered a further four *Delfin* Class torpedo boats. These, the *Laks, Sild, Sael,* and *Skrei,* were also built by Horten and were launched in 1900.

The Norwegian-built boats were both heavier and slower than the Schichau design, displacing 90 tons and achieving a speed of 23 knots. As is usual with older torpedo boats, their top speed declined to 19 or 20 knots and, after an undistinguished career, the class was scrapped during the .1920s.

Displacement: 79-90 tons (normal) *Length:* 39.01 m (128 ft) *Beam:* 4.57 m (15 ft) *Draught:* 2.13 m (7 ft) *Machinery:* 1-shaft reciprocating, 1000 ihp=23-24½ knots *Armament:* 2 37-mm (1.46-in) QF (2×1) 2 45-cm (17.7-in) torpedo tubes *Crew:* 19

Delfin

Russian submarine, built in 1904. This was the second Russian submarine to be built, and was the first modern boat designed in Russia. She was designed by Professor Bubnov and laid down at St Petersburg in 1902, launched in 1904 and completed in June 1904. She was apparently lost by accident soon after completion while lying off the Baltic shipyard, but was soon raised and put back into service.

She served with the Baltic Fleet from 1914 to 1916 but without seeing any action. In 1916 she was transferred to the Arctic, to defend Murmansk harbour, but she developed a number of leaks and finally in August 1917 she was stricken. On September 5, 1917 she was scuttled in the harbour, but the wreck was still in existence in 1919.

Displacement: 175/200 tons (surfaced/submerged) *Length:* 23.49 m (77 ft 1 in) pp *Beam:* 4.27 m (14 ft) *Draught:* Unknown *Machinery:* 1-

shaft gasoline engine/electric motor=9/5 knots *Armament:* 2 45-cm (17.7-in) torpedoes in Drzewiecki drop-collars *Crew:* 10 (approx)

Delfin, Aero L-29

Czech jet trainer aircraft. This aircraft was one of the first to demonstrate to the world that nations other than the Soviet Union can win competitive evaluations for major Warsaw Pact equipment. It was designed by a team at Aero Národní Podnik led by K Tomas and Z Rublic, and the XL-29 prototype flew on April 5, 1959.

It was powered by an imported British Viper turbojet, but production Delfins (Dolphins) have the locally developed Motorlet M-701c centrifugal-compressor engine with an interior resembling the advanced Dart turboprops but with wholly Czech engineering. This turbojet is rated at 890 kg (1962 lb) static thrust.

Competing against the Soviet Yak-30 and Polish TS-11 Iskra, the L-29 was selected as standard jet pilot trainer by all Warsaw Pact countries except Poland in 1961. Manufacture was put in hand at plants at Vodochody (Aero) and Kunovice, and series production continued until 1974 when deliveries exceeded 3000. Many of these were exported in straight commercial sales to Cuba, Egypt, Guinea, Indonesia, Iraq, Nigeria, Syria, Uganda and probably other countries, in addition to the Warsaw Pact customers.

An all-metal stressed-skin machine of conventional form, the Delfin seats the instructor behind the pupil in ejection seats at the same level. The cockpit is pressurized and is normally equipped for gunnery, rocketry and bombing training, though all weapons are attached externally, on two underwing hardpoints. The L-29R was a counter-insurgency version, but was built only in small numbers.

Another version not built in quantity was the L-29A Delfin Akrobat. This was a single-seat model specifically for display and sporting use, with gross weight restricted to 2600 kg (5732 lb). The rear cockpit is stripped and the canopy replaced by a sliding fairing, and the engine is derated to only 454 kg (1000 lb) static thrust.

NATO reporting name for the Delfin is 'Maya'. Large numbers continue in service, though from late 1973 Warsaw Pact flying training schools have progressively been receiving the Aero L-39 Albatross.

Span: 10.29 m (33 ft 9 in) *Length:* 10.81 m (35 ft 5½ in) *Gross weight:* 3540 kg (7804 lb) *Maximum speed:* 655 km/h (407 mph)

Delfinen

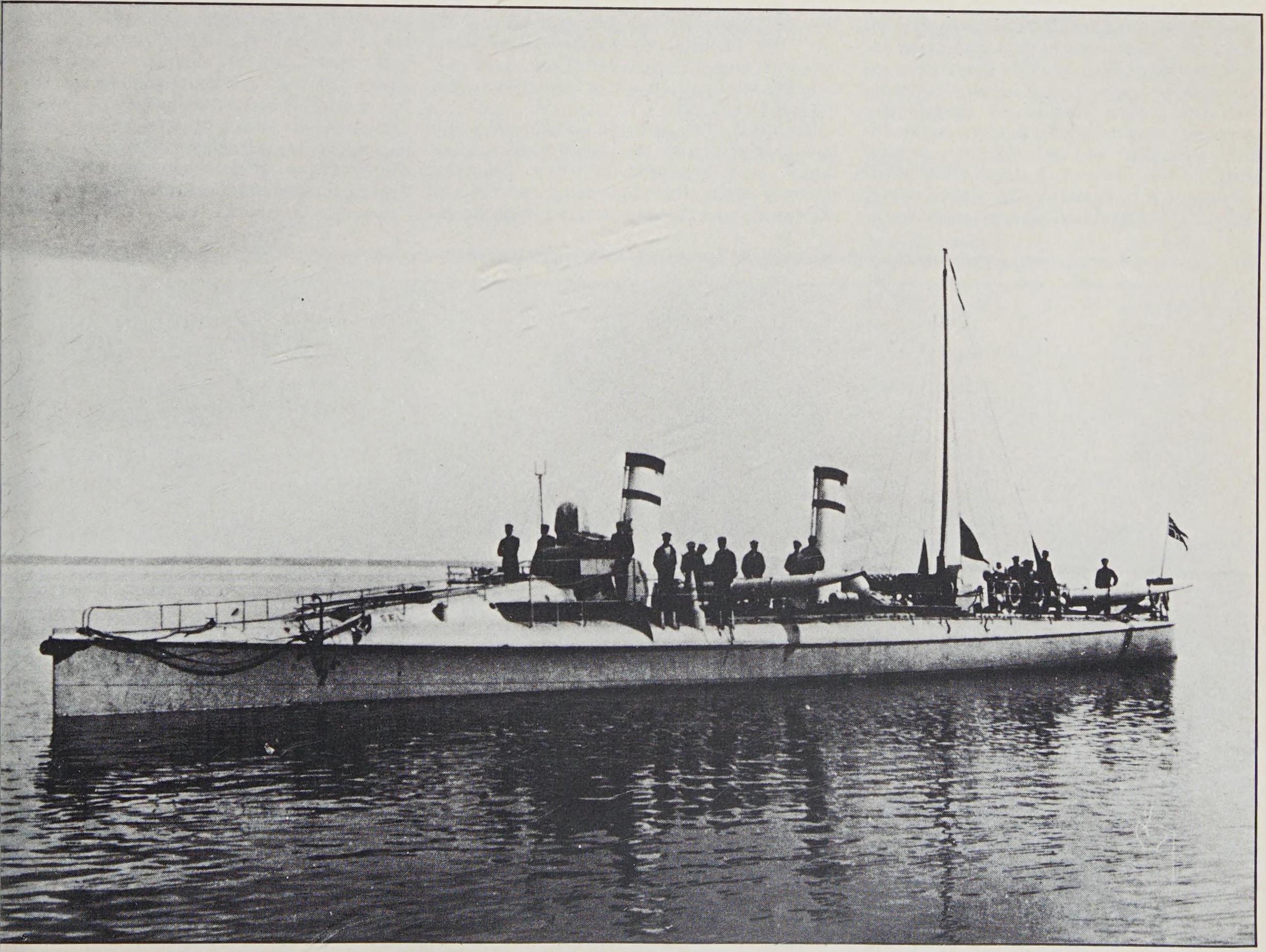
Danish submarine class, built 1954-64. These were the first submarines to be built to a Danish design after the Second World War, and in many ways they resemble the ex-British 'U' and 'V' Class boats handed over in 1946. They are of modest displacement, but are streamlined for good underwater speed, and have a snorkel mast, radar and sonar. All four boats were built by the Royal dockyard, Copenhagen.

They are conventional in appearance, with a streamlined fin and a sonar dome on the bow. The four torpedo tubes are all mounted in the bow.

Originally *Springeren* was to be built in 1959-60 with funds provided under the

Pennant no and name	launched
S.326 *Delfinen*	5/1956
S.327 *Spaekhuggeren*	2/1957
S.328 *Tumleren*	5/1958
S.329 *Springeren*	4/1963

The Norwegian torpedo boat *Sael* with her torpedo tubes aligned to port. She was one of six *Delfin* Class boats built in Norway and Britain



Mutual Defense Aid Programme (MDAP), but the contract was deferred for four years. The average cost was 17 million kroner.

Displacement: 576/643 tons (surfaced/submerged) *Length:* 54 m (177 ft 2 in) pp *Beam:* 4.7 m (15 ft 5 in) *Draught:* 4 m (13 ft 1½ in) *Machinery:* 2-shaft diesel-electric, 2600 bhp/1200 shp=13/12 knots (surfaced/submerged) *Armament:* 4 53-cm (21-in) torpedo tubes (probably 8 torpedoes carried) *Crew:* 33

Delfino

Italian submarine, built 1889-92. This small submersible was the first Italian submarine and was designed by the pioneer engineer, Inspector Giacinto Pullino. She was laid down at the Arsenal, La Spezia, in the autumn of 1889, launched in 1890, and completed in April 1892. However, she then began a series of trials, and was not officially accepted until April 1, 1895.

In her original form the *Delfino* had a cigar-shaped steel hull, with two vertical propellers on the casing and a small conning tower. She was fitted with a bow rudder, one set of diving planes at the bow, and had two 35.5-cm (14-in) torpedo tubes. The propulsion was by a single electric motor and accumulator batteries, which also drove the vertical screws.

She was directionally unstable and had a range of only 38.6 km (24 miles) at two knots, and so in 1902 she was taken in hand for complete rebuilding. In 1904, she reappeared with a new, larger conning tower, a proper deck-casing and a 'kleptoscope' (or primitive periscope). She now had a gasoline engine for surface-running, and only the after vertical propeller was retained. A single 45-cm (17.7-in) torpedo tube replaced the original pair of 35.5-cm (14-in) torpedo tubes mounted in the bow. Another refinement was the provision of a second pair of diving planes aft, which made her much more manoeuvrable.

During the First World War, the *Delfino* was used to guard the outer approaches to Venice, and was not paid off until September 1918. In June 1919 she was stricken and scrapped.

Displacement: 98/108 tons (surfaced/submerged) increased to 103/113 tons in 1902-04 *Length:* 24 m (78 ft 10 in) oa (as built), increased to 24.68 m (80 ft 11½ in) in 1902-04 *Beam:* 2.89 m (9 ft 5¾ in) *Draught:* 2.56 m (8 ft 4¾ in) (as built); 2.79 m (9 ft 2 in) (as modified) *Machinery:* (As built) 1-shaft electric motor, 65 shp=6/5 knots (surfaced/submerged) (As modified) 1-shaft gasoline engine/electric motor, 130 bhp/65 shp=6/5 knots (surfaced/submerged) *Armament:* (As built) 2 35.5-cm (14-in) torpedo tubes (As modified) 1 45-cm (17.7-in) torpedo-tube *Crew:* 8 (increased to 11)

Delhi

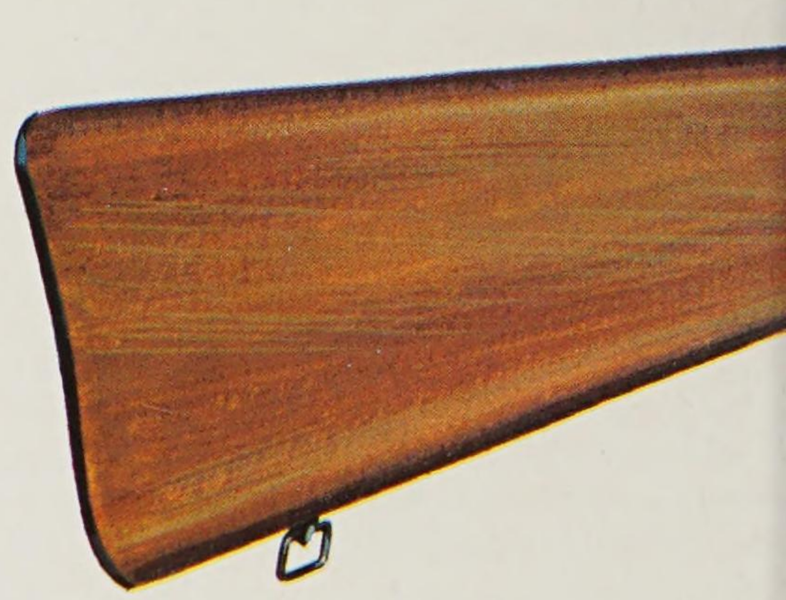
Indian cruiser. The *Delhi* was originally HMS *Achilles*, one of the *Leander* Class cruisers of the 1929 Programme. She was laid down by Cammell Laird at Birkenhead on June 11, 1931, launched on September 1, 1932, and completed on October 10, 1933. She was manned by the Royal New Zealand Navy from 1936 to 1943 during which period she became famous for her part in the Battle of the River Plate. In the Second World War one twin 6-in (152-mm) turret was removed reducing her main armament from eight to six 6-in (152-mm) guns.

On July 5, 1948, she was purchased by the Indian government and transferred to the Indian navy in October, when she was renamed *Delhi*. Her close range antiaircraft armament was modernized to provide a uniform battery of 14 40-mm (1.57-in) Bofors guns (4×2+6×1) but the remaining guns, six 6-in (152-mm) (3×2) and eight 4-in (102-mm) (4×2) remained as before. In 1958 her two triple 21-in (53-cm) torpedo tube mountings were removed and the forecastle side and deck plating was extended to fill the space that they had occupied. These were the only alterations made since the ship was transferred. She was flagship of the Indian navy until 1957 when she was relieved by the cruiser *Mysore* (ex-HMS *Nigeria*).

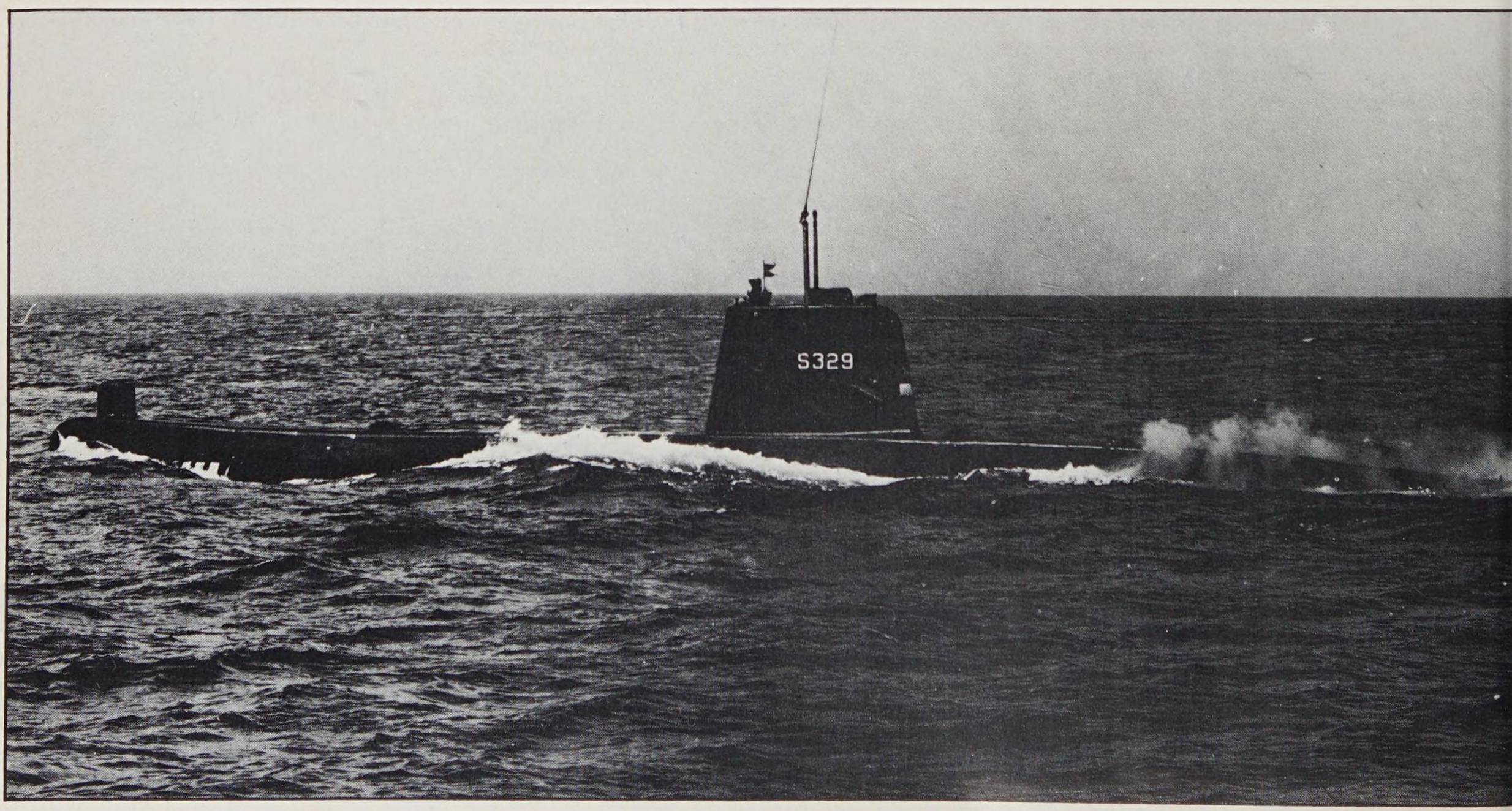
Although one of the oldest cruisers in existence she still has a limited level of usefulness for subsidiary service, such as shore support and patrol work and is at present largely employed on training duties.

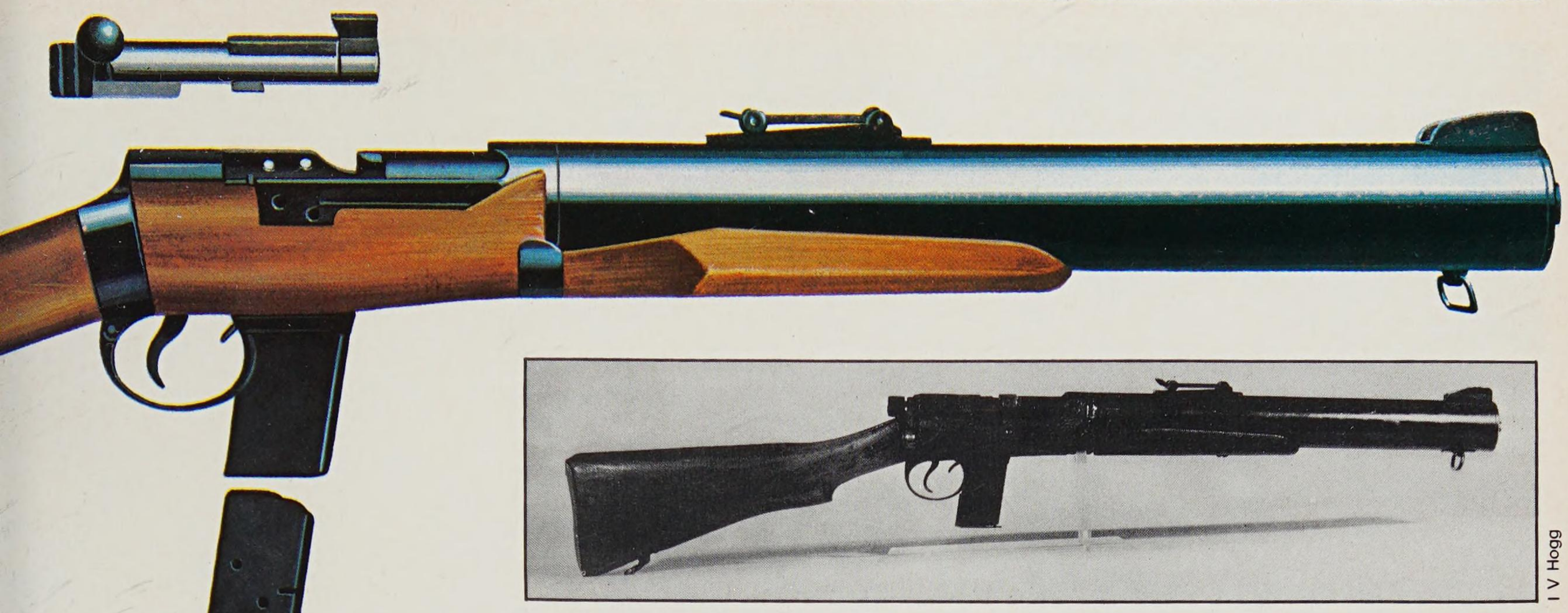
See also *Leander* Class.

The De Lisle carbine, with bolt and magazine removed. This silent weapon was based on the Lee-Enfield rifle and 45-calibre round with a Maxim silencer. The low velocity of the round meant that there was no 'crack', and the 'thump' from the cartridge was muffled by the silencer. The only operating noise was the bolt action



The Danish submarine *Springeren*, one of the four *Delfinen* Class vessels built in the late 1950s to a design similar to the British 'U' and 'V' Class





I V Hogg

The De Lisle carbine, used during the Second World War by Commandos, special forces and clandestine groups for killing sentries and assassinating political and military opponents

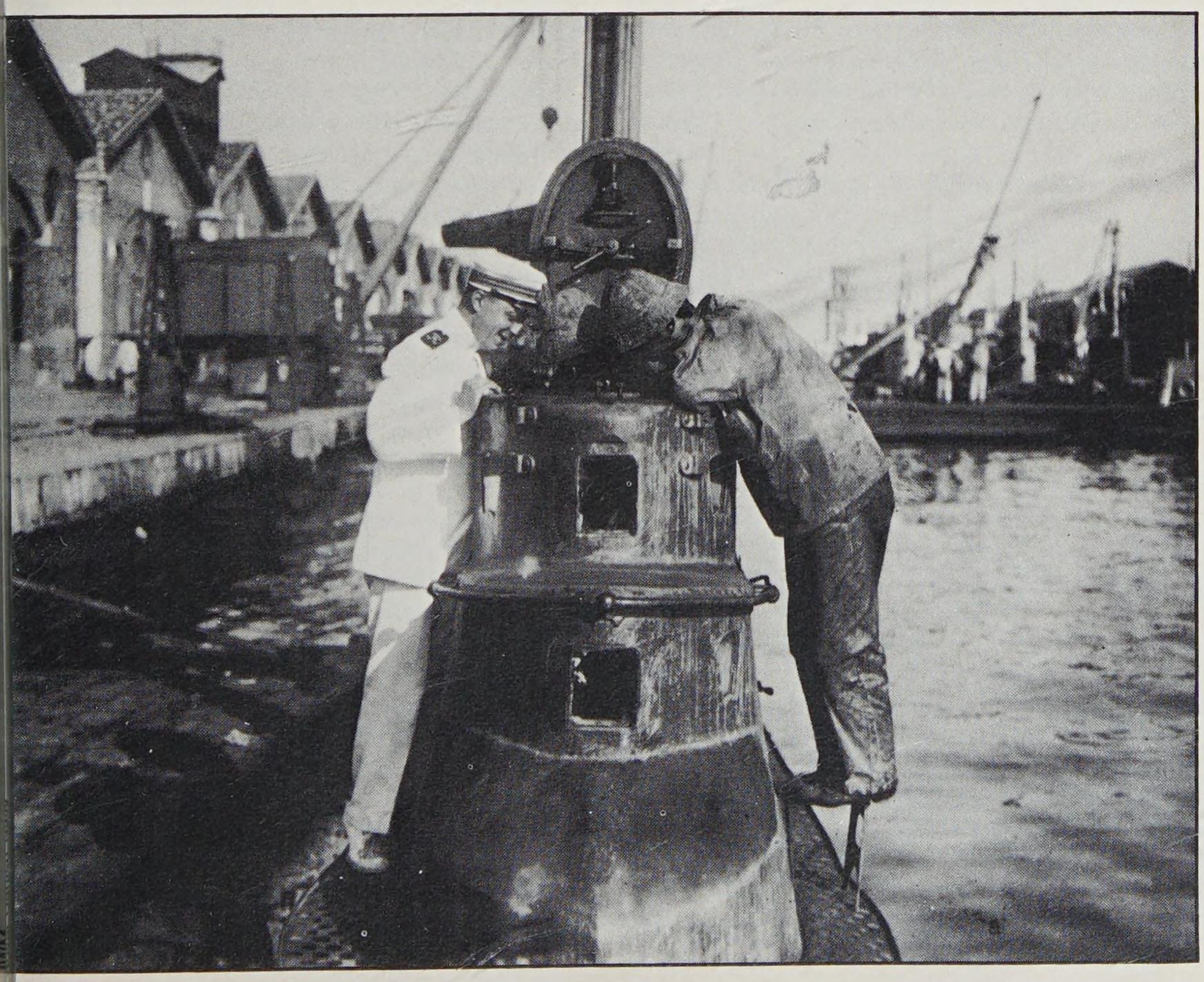
De Lisle

British carbine. The De Lisle carbine was a silenced single-shot weapon produced during the Second World War for use by commandos, rangers and clandestine organisations. It consisted basically of the Lee-Enfield bolt action, a .45-calibre barrel, and a large and efficient Maxim silencer, all mounted on a Lee-Enfield pattern rifle stock.

In providing a silenced weapon, it is not sufficient merely to silence the noise of the cartridge—the bullet, if it travels at above the speed of sound, makes a characteristic noise. For this reason, the De Lisle was chambered for the 0.45-in (11.4-mm) Auto Colt Pistol cartridge which when fired through the De Lisle barrel had a velocity of about 274 m/sec (900 ft/sec), sufficiently below the sonic threshold to make it fly silently. The barrel was perforated and allowed the propelling gas to leak out into the silencer, where a series of baffles lowered the gas velocity and temperature before releasing them to the atmosphere. It was the most silent of any weapon developed during the war, though the effect was perhaps ruined by the noise made in working the bolt. Two types of De Lisle appeared: one with the standard wooden butt, and a later model with a collapsible metal stock.

Displacement: 7114 tons (standard), 9740 tons (full load) *Length:* 158.8 m (521 ft) pp, 166 m (544 ft) oa *Beam:* 16.8 m (55 ft 1 in) *Draught:* 6.1 m (20 ft) *Machinery:* 4-shaft Parsons geared turbines, 72 000 shp=32 knots *Protection:* 51-102 mm (2-4 in) sides; 25 mm (1 in) turrets; 25 mm (1 in) bridge; 51 mm (2 in) deck *Armament:* 6 6-in (152-mm) (3×2); 8 4-in (102-mm) (4×2); 14 40-mm (1.57-in) (4×2, 6×1); 3-pdr saluting guns *Crew:* 800

The Italian submarine *Delfino*, used for harbour defence at Venice during the First World War



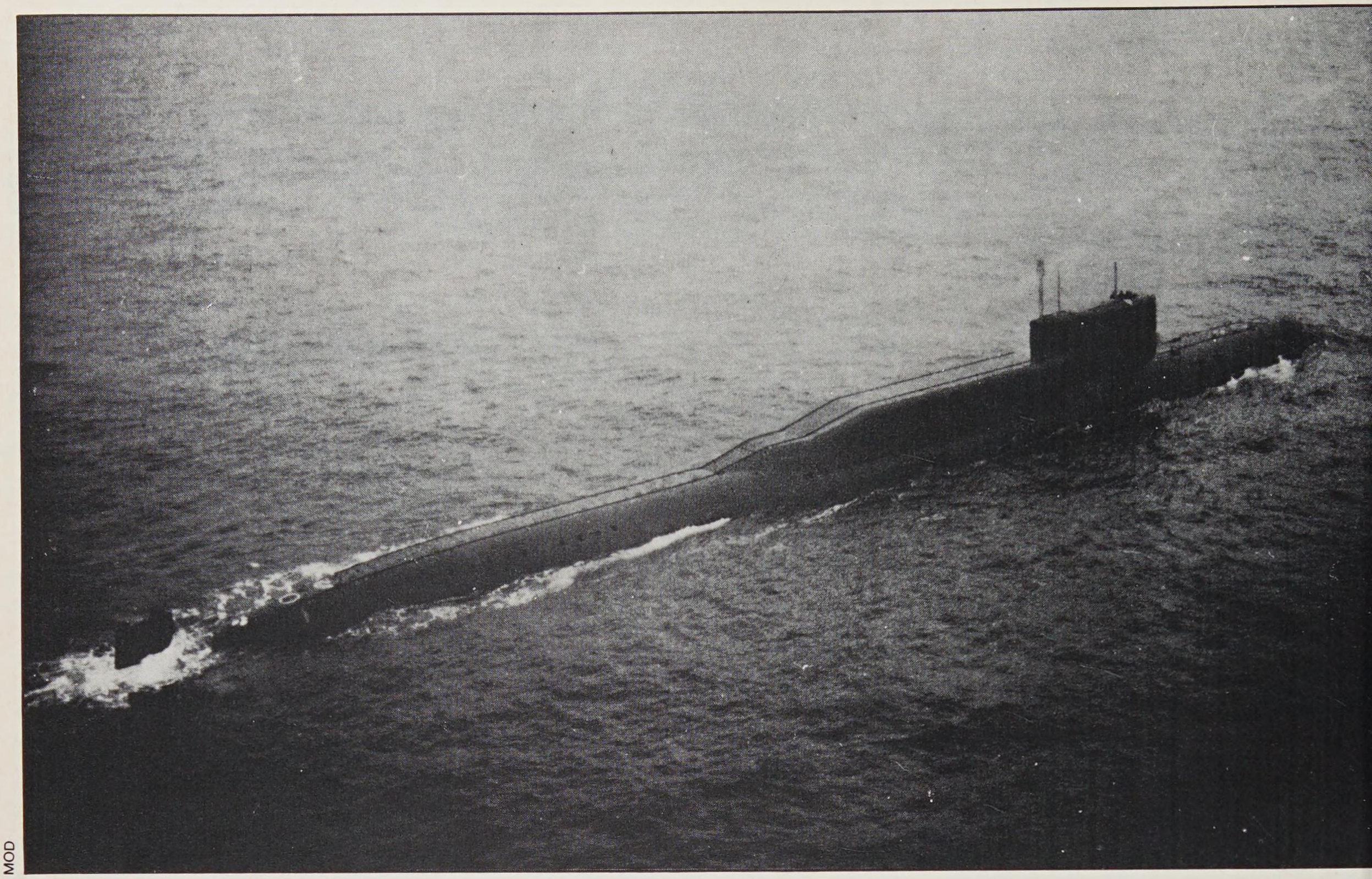
Delphin

Greek submarine class, built 1910-12. The French Schneider firm of Chalons-sur-Sâone obtained contracts for submarines before the First World War, partly because they had acquired the services and the patents of Maxime Laubeuf, the pioneer submarine designer.

Name	launched
Delphin	2 August 1911
Xiphias	29 June 1912

The cost of these two submarines was defrayed by public subscription, in the upsurge of nationalist fervour before the Balkan War. In appearance they resembled the contemporary Schneider-Laubeuf boats built for the French navy with a broad casing and a low conning tower. The armament was heavy, five 45-cm (17.7-in) torpedoes, one mounted internally in the bow, and four in Drzewiecki drop-collars externally. One reload was carried for the bow-tube. Both boats were in poor shape after the Allied occupation of Athens and the virtual seizure of the Greek navy, and were scrapped in the early 1920s.

Displacement: 300/460 tonnes (surfaced/submerged) *Length:* 50 m (164 ft) *Beam:* Unknown *Draught:* Unknown *Machinery:* 2-shaft diesel/electric, 1850 hp/720 shp=14/9



MOD

A Soviet *Delta* Class ballistic missile submarine, with a displacement of 9000 tons and the ability to carry and launch 12 SS-N-8 missile

knots (surfaced/submerged) *Armament:* 1 45-cm (17.7-in) torpedo tube (bow, 2 torpedoes carried); 4 45-cm (17.7-in) torpedoes in drop-collars (external, beam) *Crew:* 25

Delta

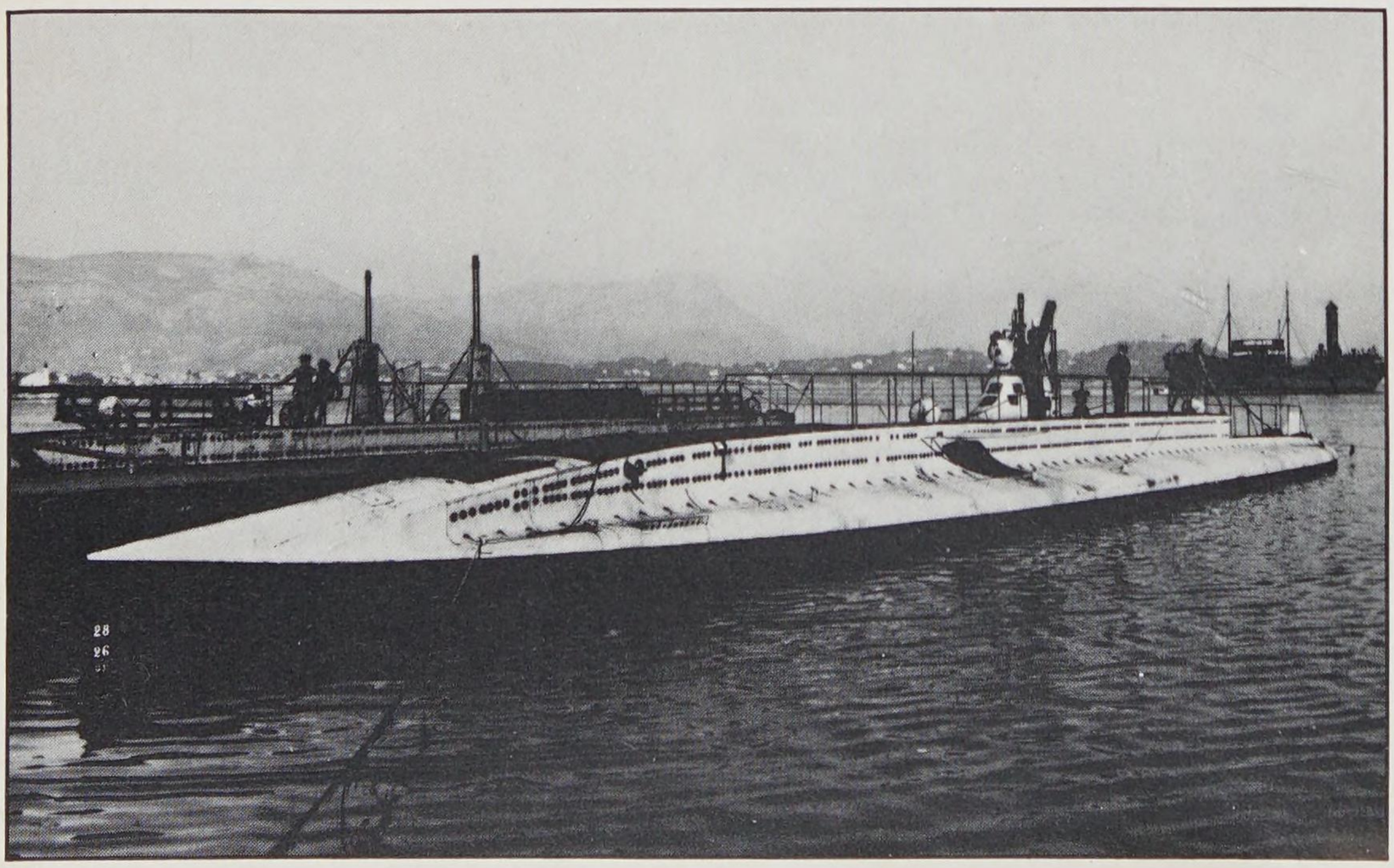
Russian nuclear submarine class code-name. The existence of these Soviet ballistic missile-firing nuclear submarines (SSBNs) was announced at the end of 1972. In general they follow the pattern of the US Navy's Polaris submarines, but they have only 12 tubes for launching the 6437-km (4000-mile) SS-N-8 missile.

The *Delta* Class are built at Severodvinsk (formerly Molotovsk), north-west of Arkhangelsk, and first estimates suggested that ten or 12 could be turned out each year. However, later observations suggest that this would put an unbearable strain on Soviet resources of material and manpower, and the figure has been whittled down to six-eight boats per year. Even so, only ten *Deltas* have been reported. Since November 1973, the type has been followed by the bigger *Delta II*.

The *Delta II* can carry 16 of the big and bulky SS-N-8s, and is reputed to displace 16 000 tons. This makes it the biggest submarine ever built: a reflection on the Russian inability to keep the size of their rocket motors down, rather than proof of any advance in striking power. In 1976, two of these boats were reported, with another two building.

The future of the *Delta II* programme depends on the final outcome of the Strategic Arms Limitation Talks (SALT), but the existence of these boats has a direct bearing on the US Navy's decision to continue the *Trident* SSBN programme.

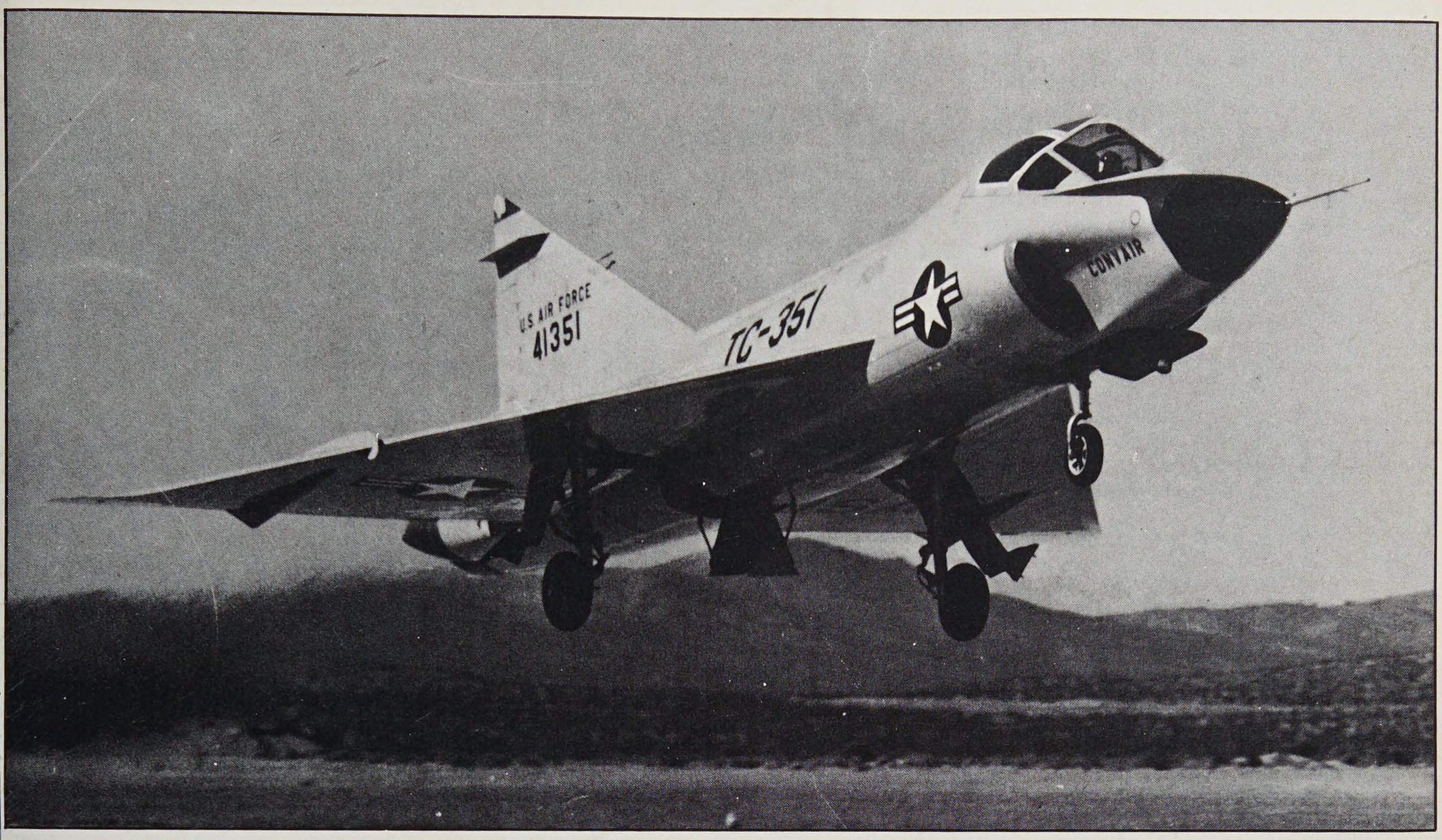
The Greek submarine *Xiphias*, one of the two *Delphin* Class bought by public subscription



Marius Bar

(Delta I) *Displacement:* 9000/10 000 tons (surfaced/submerged) *Length:* 137.2 m (450 ft 1½ in oa *Beam:* 10.6 m (34 ft 9¼ in) *Draught:* 10 m (32 ft 9¾ in) *Machinery:* 2-shaft nuclear reactor+steam turbines, 24 000 shp=25 knots (surfaced/submerged) *Armament:* 12 SS-N-8 underwater-launched IRBMs; 8 53-cm (21-in) torpedo tubes *Crew:* 120 approx

(Delta II) *Displacement:* 16 000 tons (approx) *Length:* 152 m (498 ft 8¼ in) *Beam:* 11 m (36 ft 1 in) *Draught:* 10 m (32 ft 9½ in) *Machinery:* Probably identical to Delta I *Armament:* 16 SS-N-8 underwater-launched IRBMs; 8 53-cm (21 in) torpedo tubes *Crew:* 40 approx



A Convair TF-102A Delta Dagger trainer combat interceptor takes off on a practice mission. The Delta Dagger served with the USAF until 1972

Delta Dagger, Convair F-102

US all-weather interceptor aircraft. Convair, part of the General Dynamics corporation, was the pioneer of supersonic delta-winged aircraft. Using German wartime data (some of it based on concepts by Dr Alex Lippisch) on subsonic and supersonic deltas, a programme for a delta all-weather interceptor was funded by the US Air Force as the XF-92. Eventually this was recast as the XF-92A research aircraft, the first delta in the world, which flew in 1948.

By this time the USAF was far advanced with the new Hughes Aircraft company in planning an all-weather interception system that would be largely, if not completely, automatic in operation. The system was to comprise advanced radar, autopilot, data-links, interfaces with the aircraft-powered flight-control system, spin-stabilized rockets and air-to-air guided missiles. Most portions of the system, including the missile, were assigned to Hughes.

Designated MX-1179, this system was by far the most advanced interception equipment even considered at that time, in 1949-52. A completely new aircraft had to be designed to carry it, and it was stipulated that this should have supersonic speed in level flight (then a feat accomplished only by short-duration research aircraft).

Convair won the industry competition with the Model 8, or XF-102. It was planned as a single-seater, with the new Pratt & Whitney J57 two-shaft turbojet with afterburner, fed by two lateral inlets to leave the nose free for the radar. The wing had pure delta shape, 60° leading-edge sweep and very low thickness/chord ratio. Trailing-edge surfaces were powered and irreversible and worked as elevons, in the absence of a horizontal tail.

The prototype YF-102 flew on October 24, 1953. As trials progressed, it became evident that it was incapable of exceeding Mach 1 (the speed of sound) even in a dive. After urgent research the whole airframe was repackaged and reshaped according to the NACA Area Rule (which stipulates shapes for minimum transonic and supersonic drag). The fuselage was extended in length, made fatter ahead of and behind the wing, slightly waisted in the centre and considerably revised in profile. The wing was changed in profile to have conical camber, the leading edge arching down towards the tips, and later the delta vertical tail was increased in height.

Production began in late 1955 and in the subsequent 21 months 875 F-102 Delta Daggers were delivered, backed up by 63 TF-102A dual-control trainers with side-by-side seating that limited maximum speed to about 1040 km/h (646 mph), well below sonic speed.

When first delivered the F-102A was armed with up to six Hughes Falcon air-to-air missiles, carried in an internal bay under the wing closed by doors which incorporated launch tubes for 24 Mighty Mouse spin-stabilized rockets. The Falcon, at first designated XF-98, then GAR-98 and later AIM-4, passed through a succession of improvements and several versions served with the F-102 squadrons of USAF Aerospace Defense Command. After 1960 there was usually a mix of the AIM-4E with semi-active radar homing and the AIM-4F with infrared heat-homing. To assist IR seeker cells in the Falcons to lock on their target before launch, a sensitive heat-seeker was added as a field modification ahead of the pilot's acutely sloped V-shaped windshield. Later the spin-stabilized rockets were removed.

Powered by a J57-23 rated at 7800 kg (17 200 lb) with afterburner, the F-102 —called The Deuce, from its number— served with the USAF until 1972, by which time most had been passed to the Air National Guard. The Greek air force was by 1978 retiring the F-102A Deuces of 342 Squadron though the TF-102A was still being used as a trainer. The Turkish air force still had two interceptor squadrons with 35 aircraft. All the Greek and Turkish machines were ex-USAF. In the United States, Sperry has converted at least 24 into remotely-piloted QF-102A and PQM-102A versions, the former for threat evaluation and research and the latter a drone target.

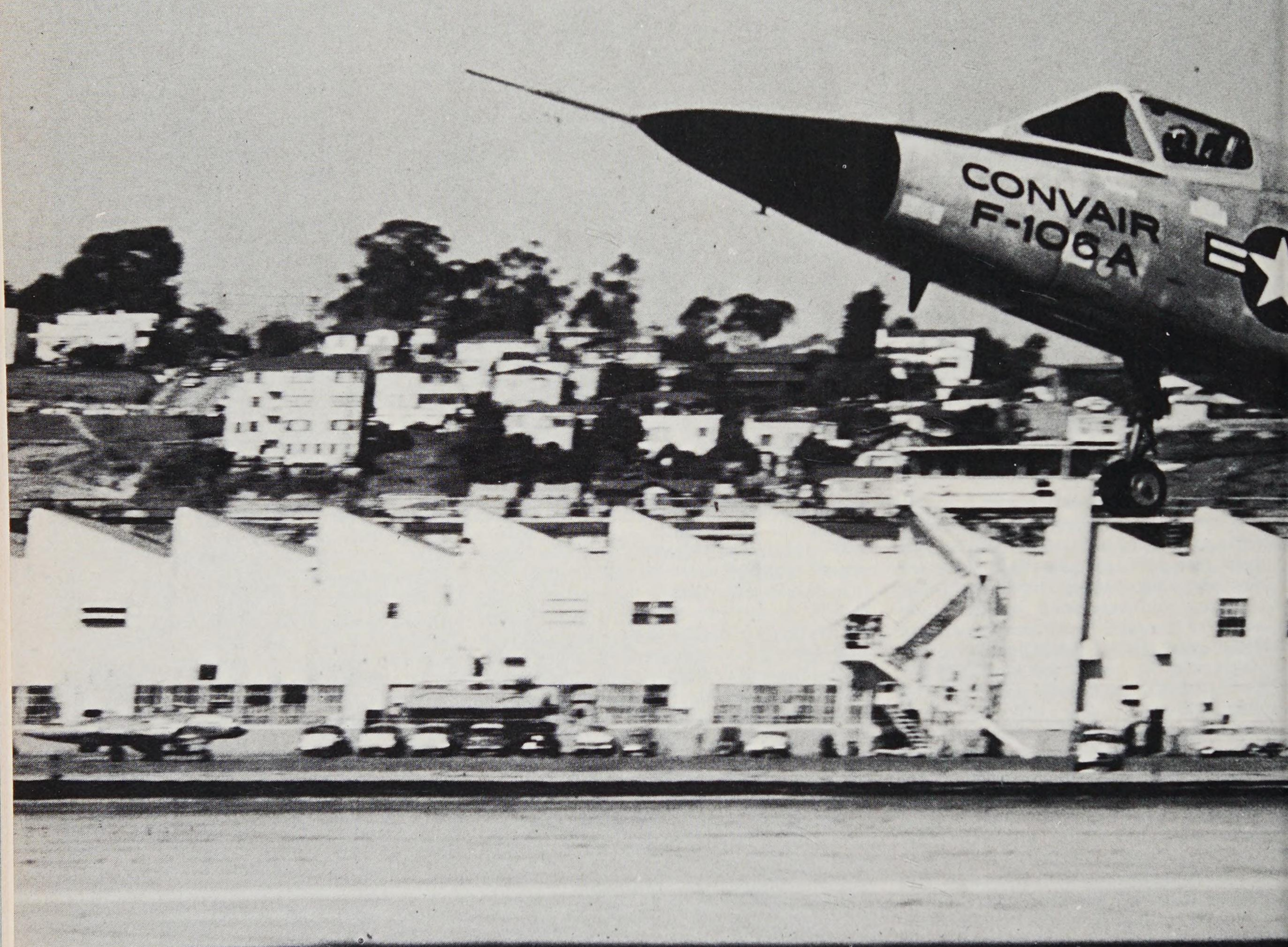
Span: 11.6 m (38 ft 1½ in) *Length:* 20.85 m (68 ft 5 in) *Gross weight:* 14 288 kg (31 500 lb) *Maximum speed:* Mach 1.25 (1328 km/h, 825 mph)

Delta Dart, General Dynamics F-106

US interceptor aircraft. Though derived from the F-102 Delta Dagger, and originally designated F-102B, the F-106 is approximately twice as fast and has a totally different airframe, engine, systems and armament. Planned quickly as an improved interceptor designed to the Area Rule (for minimum supersonic drag) from the start, it was expected to be replaced by a later interceptor by 1960. It is still in service, and is the only aircraft in its category in the United States. For more than 20 years various replacements have been funded or studied but none has entered service.

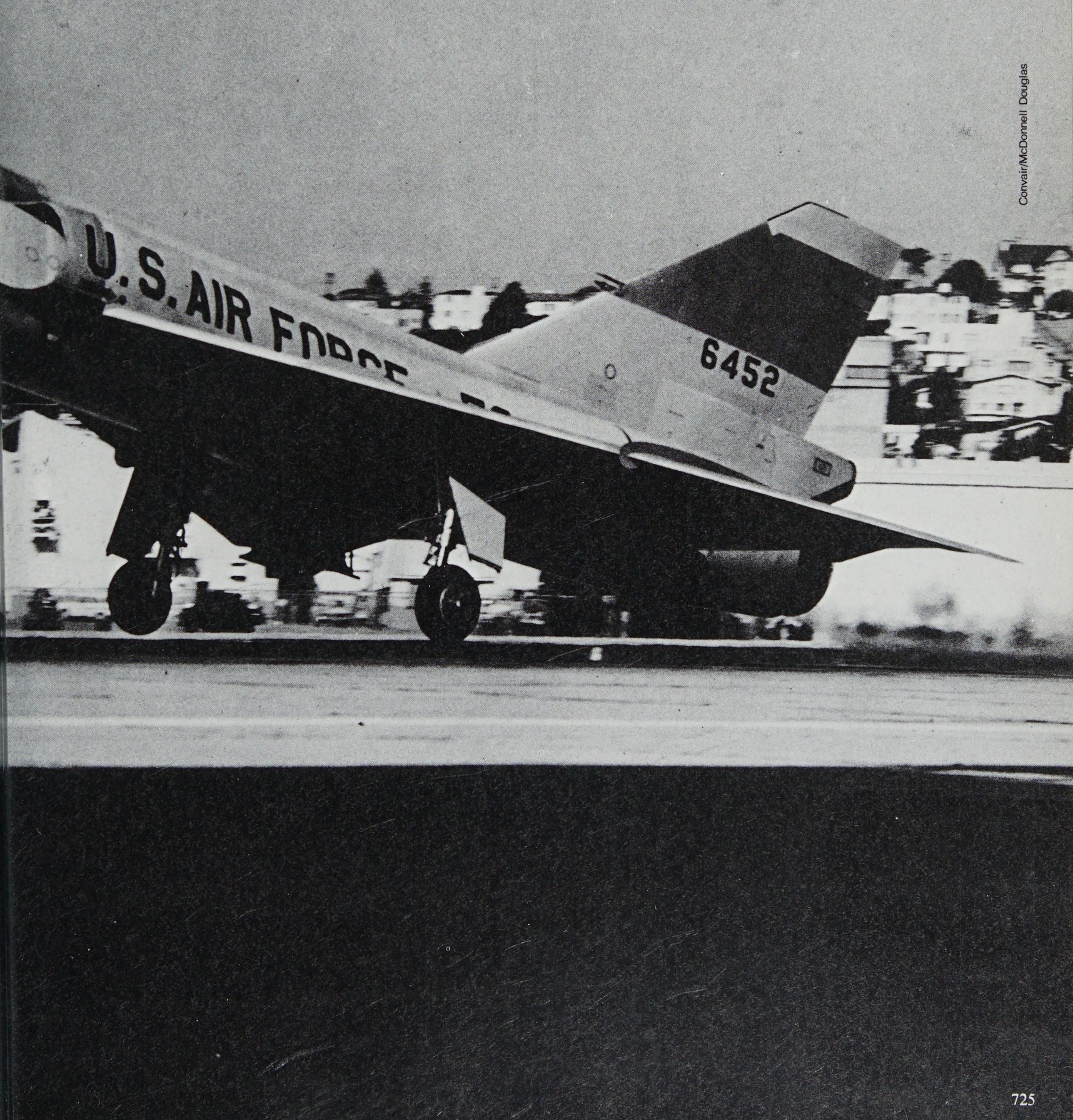
Rather longer and better profiled than the F-102, the F-106 is powered by a Pratt & Whitney J75-17 two-shaft turbojet, with max-

Delta Dart



Delta Dart

A Convair F-106A Delta Dart single-seat intercepter fighter takes off. Delta Darts have an internal bay for AAMs and a typical load consists of two AIR-2A or AIR-2B Genie unguided rockets and four AIM-4E or AIM-4G Falcon AAMs. A 20-mm (0.79-in) M-61 multi-barrel rotary cannon was introduced in 1973 as a standard fitting. The F-106 was based on the earlier F-102 but had a redesigned fuselage with an uprated J75 engine. The F-106B is identical except that it has a reduced fuel capacity to allow a second man in the cockpit. The F-106B is used either as a proficiency trainer or a two-seat intercepter. Both types were introduced into service with the Aerospace Defense Command of the USAF and operated over North America as part of the Semi-Automatic Ground Environment (SAGE) defense system. After flight experience a number of improvements were introduced including the M-61 cannon in a semi-retractable installation in the weapons bay with a SnapShoot gunsight for dog-fighting, drop tanks and inflight refuelling equipment



Convair/McDonnell Douglas

imum afterburner rating of 11 130 kg (24 500 lb) static thrust. Allied with the sleek airframe and more efficient inlet ducts, this gives a speed well in excess of Mach 2, and the aircraft established a world record at the speed of 2455 km/h (1525 mph). Later the F-106 was fitted with two supersonic underwing fuel tanks which stretched the range to a maximum of 2735 km (1700 miles).

The F-106 was designed around a completely new Hughes interception system, the MA-1. This is slightly more extensive and heavier than the F-102 system, but has several times the capability. As finally developed, the MA-1 includes a data-link interfacing with the US nationwide SAGE (Semi-Active Ground Environment) and a digital computer to take fast decisions in tracking targets and selecting, aiming and firing weapons.

The armament was designed to be carried in a weapon bay similar to that of the F-102, and normally comprises two each of the AIM-4E and -4F Falcons plus two Genie air-to-air rockets of the AIR-2A or -2G type with optional nuclear warhead. After 1970 a need for close inspection of targets and possible subsequent close combat led to the requirement for an internal gun. At the expense of part of the missile armament, a 20-mm (0.79-in) M61 Gatling cannon has been installed, with its ammunition drum, in a novel way in the underside of the fuselage. Other modifications have updated the electronics and ECCM (electronic counter-counter-measures), added fresh sensors, improved flight-refuelling and incorporated other new features.

Only 277 F-106A Delta Darts were bought for USAF Aerospace Defense Command, plus 63 tandem-seat F-106B trainers which, unlike the TF-102A, are approximately as fast as the fighter. By 1978, the interceptor force defending North America had been reduced to five ADC and five Air National Guard squadrons, with some 125 active aircraft, all of them of the F-106 type. There are also a handful of units still flying the F-101B (phasing out) and F-4, but the requirement for a new interceptor has been increasingly evident. The choice may be the F-14 or F-15. One of the problems has been the urgent need to save money, accentuated by inflation, and the belief in the 1960s that the threat from possible hostile aircraft had receded.

Span: 11.67 m (38 ft 3½ in) *Length:* 21.55 m (70 ft 8¾ in) *Gross weight:* 17 350 kg (38 250 lb) *Maximum speed:* 2455 km/h (1525 mph)

A Convair YF-102A Delta Dagger in flight in April 1944. Based on the delta wing research by Dr Alex Lippisch, the F-102A was originally armed with six Hughes Falcon air-to-air missiles in an internal bay with doors which incorporated launch tubes for 24 Mighty Mouse spin-stabilized rockets. This armament was up-dated and improved and with delivery of improved Falcons the Mighty Mouse rockets were removed. The USAF received 975 F-102As and 63 TF-102As (the two seater trainer) and some ex-USAF machines were transferred to the Greek and Turkish air forces

Below: **A USAF Convair F-106A Delta Dart deploys its brake parachute as it touches down**

Demon, Hawker

British two-seat interceptor fighter aircraft. A fighter variant of the Hawker Hart bomber, the Hart Fighter (renamed Demon in July 1932) first appeared in March 1931 and the first example went to 23 Squadron for evaluation. The first production Demon (K2842) made its initial flight on February 10, 1933. By April, the first wholly-equipped unit, 23 Squadron, replaced its former Bristol Bulldogs. By end of 1934, Demons had equipped 41, 64, 600, 601 and 604 Squadrons, RAF and AAF; while March 1935 saw the first 18 of a total of 64 Demons delivered to the RAAF. By 1938 a further six squadrons were flying Demons.

At the close of 1934, Demon J9933 had been fitted with the prototype Frazer-Nash hydraulic-operated rear gun 'turret', featuring 'lobster-back' protective shielding. This feature was incorporated in Boulton Paul-

Below: **Four F-102As of 148th Fighter Group, of the Minnesota Air National Guard (ANG) practising for the 1970 William Tell weapons meet in Florida. The competition was held between the Aerospace Defence Command, National Guard and Canadian Armed Forces**

The Hawker Demon, the fighter version of the Hawker Hart bomber developed in the 1930s, featured an open observer/rear gunner's position. In 1934 one Demon was fitted with the prototype Frazer-Nash hydraulic-operated rear gun 'turret' with 'lobster-back' protective shielding which covered the gunner when he traversed to engage targets

built Demons from mid-1936. The first two-seat fighter introduced into the RAF since 1918, the Demon was officially declared obsolete by September 1939, and replaced in operational units. Several examples continued in training use as target tugs until early 1944.

Span: 11.3 m (37 ft 2 in) *Length:* 9 m (29 ft 7 in) *Height:* 3.2 m (10 ft 5 in) *Maximum speed:* 113 km/h (182 mph) at 3962 m (13 000 ft) (Kestrel IIS) *Service ceiling:* 7467 m (24 500 ft) (Kestrel IIS) *Climb:* 3048 m (10 000 ft) in 7 minutes 25 seconds (Kestrel IIS) *Armament:* 2 0.303-in (7.7-mm) Vickers mg firing forward; 1 0.303-in (7.7-mm) Lewis machine-gun in rear cockpit

Demon, McDonnell F-3

US carrier-based jet fighter aircraft. The Demon was built to a US Navy requirement for a single-seat, high-performance interceptor able to equal the capabilities of its land-based contemporaries. Following McDonnell's excellent FH-1 Phantom and F2H Banshee, the Demon was the least successful of the series—entirely because of the total failure of the chosen engines.

Two Demon prototypes were ordered on September 30, 1949, in which McDonnell departed from its previous designs by using a single-engined layout with lateral-type intakes close to the nose, and sweptback wings and tail. Powerplant was a 3266-kg (7200-lb) static thrust Westinghouse XJ40-WE-6 afterburning turbojet to which most of the failures of the aircraft were attributed. (It was reported that some $200 million was spent in abortive attempts to put the initial version of the Demon into service.)

The first XF3H-1 prototype flew on August 7, 1951, but crashed soon afterwards; a further ten accidents were to occur during initial flight trials, claiming the lives of four test pilots. Prior to the first flight, the US Navy had ordered 150 of the F3H-1N, which was intended to have all-weather capability and more fuel than the prototypes. The gross weight was thereby increased to 13 154 kg (29 000 lb), and the more powerful J40-WE-24 was to be installed. In the event, this engine failed to achieve its design rating, and only 56 F3H-1Ns were delivered, all with 3266-kg (7200-lb) static thrust J40-WE-22 engines.

Deliveries of the F3H-1Ns began in March 1953. Because of their lack of power, 21 were reserved for shore-based training duties, and were later grounded permanently, while 29 others (six having been lost in accidents) were re-engined with Allison J71-A-2 engines giving 6464-kg (14 250-lb) static thrust with afterburning. With the wing area also increased, by extending the roots forward, they were then redesignated F3H-2, flying for the first time in this form in June 1955.

In addition to the F3H-1Ns converted to F3H-2, a further 239 F3H-2s were built, as strike fighters with various underwing bomb or rocket loads. Sixty-three F3H-2Ms, armed with four AIM-7C Sparrow III air-to-air missiles, were built as limited all-weather fighters; and 67 F3H-2Ns, for a similar role, with four AIM-9C Sidewinders. All versions had four built-in 20-mm (0.79-in) cannon.

When the new US tri-service designations were introduced in late 1962, the F3H-2/2M/2N became, respectively, the F-3B, MF-3B and F-3C, the numbers having meanwhile been made up to 95 MF-3Bs and 125 F-3Cs by converting more of the Demons originally ordered under F3H-1N contracts. Some conversions were also made to unarmed RF-3B photographic reconnaissance aircraft.

Demons served with both the Atlantic and Pacific Fleets of the US Navy, and when production ended in November 1959, a total of 517 had been built. They were the first aircraft in action with guided air-to-air missiles in the Lebanon and over Quemoy in 1957-59. They were gradually phased out from 1965 in favour of the F-4 Phantom II.

(F-3B) *Span:* 10.77 m (35 ft 4 in) *Length:* 17.96 m (58 ft 11 in) *Gross weight:* 15 377 kg (33 900 lb) *Maximum speed:* 1041 km/h (647 mph)

D'Entrecasteaux

French protected cruiser of 1898. The *D'Entrecasteaux* was designed for colonial service and had her hull sheathed with teak and copper to prevent fouling. She was one of the more handsome French cruisers of her day, with three funnels and high freeboard, but she was never able to reach her designed speed of 19½ knots.

In August 1914, she was in reserve at Toulon, but soon recommissioned for service with the Mediterranean Fleet. She was one of a number of French ships guarding the Otranto Strait against a breakout by the Austrians, but in December 1914 she was detached to Syria. Early in 1915 she took part in the defence of the Suez Canal against the Turkish attack, and was stationed in Lake Timsah. After bombarding Gaza in 1916, she was relegated to escorting convoys, but in 1918 she was used to carry troops between Taranto and Itea, and continued in this service after the Armistice.

Up to October 1919, she was engaged in repatriating troops of the Armée d'Orient, and then she was hulked as a training ship for signalmen, shipwrights and reserve officers at Brest. She was lent to Belgium as a training ship from 1923 to 1927, and then to Poland. As the *Baltyk* and later the *Karl Ladislaw IV* she was based at Gdynia, training personnel for the Polish navy. She was scrapped at Gdynia in 1938.

Displacement: 8114 tonnes (normal) *Length:* 130 m (426 ft 6 in) pp *Beam:* 17.9 m (58 ft 8¾ in) *Draught:* 7.5 m (24 ft 7¼ in) *Machinery:* 2-shaft triple-expansion, 13 500 ihp= 19½ knots (designed) *Protection:* 85-30 mm (3.3 in-1.18 in) deck; 230 mm (9 in) turrets; 72 mm (2.8 in) gunshields; 52 mm (2.05 in) casemates; 250 mm (9.8

in) conning tower *Armament:* 2 240-mm (9.4-in)/40-cal Model 1893 (2× 1); 12 138.6-mm (5.5-in)/45-cal Model 1893 (12× 1); 12 47-mm (1.85-in)/50-cal Model 1885 (12× 1); 6 37-mm (1.46-in) *Crew:* 521

Denver

American cruiser class, authorized in March 1899. Six so-called 'peace cruisers', corresponding to the British category of sloops or 3rd Class cruisers, were ordered after the Spanish-American war. Although as big as the *Cincinnati* Class they had only two-thirds the power; this meant two knots less speed, but they were capable of a higher sustained speed. In addition, they were sheathed with pine and coppered to prevent fouling in tropical waters, and had good coal capacity.

The armament of ten 5-in (127-mm) Mk VI was criticized when they were built, but it was adequate for their role. The 27.2-kg (60 lb) shell had a 12.2-kg (27-lb) smokeless powder charge, giving a muzzle velocity of 883.9 m (2900 ft)/second. Two of the guns were mounted on the poop and forecastle, and the remainder in a broadside battery a deck lower. No torpedo tubes were fitted.

Severe problems with contractors meant that the class took a long time to build. The *Chattanooga* and *Galveston* both had to be towed to navy yards for completion after their builders went bankrupt.

Most of their peacetime service was in the Philippines and the Caribbean. The original light schooner-rig, intended for long-distance cruising, was removed before 1914. The ships were not employed in the Atlantic during 1917-18, as they were considered too slow and undergunned. By 1920, the armament was reduced to eight 5-in (127-mm) guns, and they were rerated as gunboats, with the classification PG.28-33. However, this was quickly revised to light cruisers CL.16-21.

The *Tacoma* (CL.20) was wrecked off the coast of Mexico on January 16, 1924. *Chattanooga* (CL.18), *Cleveland* (CL.21) and *Des Moines* (CL.17) were stricken in December 1929, *Galveston* (CL.19) in November 1930 and *Denver* (CL.16) in March 1931.

Name	launched	commissioned	built
Denver	6/1902	5/1904	Neafie & Levy
Des Moines	9/1902	3/1904	Fore River company
Chattanooga	3/1903	10/1904	Crescent shipyard
Galveston	7/1903	2/1905	Wm R Trigg company
Tacoma	6/1903	1/1904	Union Ironworks
Cleveland	9/1901	11/1903	Bath Ironworks

Displacement: 3191 tons (normal) *Length:* 94.1 m (308 ft 9 in) (oa) *Beam:* 13.4 m (44 ft 0½ in) *Draught:* 4.5 m (14 ft 9 in) (mean) *Machinery:* 2-shaft vertical triple-expansion, 6135 ihp=16¾ knots *Protection:* 50.8 mm (2 in) deck (slopes), 12.7 mm (0.5 in) (flat) *Armament:* 10 5-in (127-mm)/50-cal QF Mk VI (10×1); later reduced to 8 5-in (127-mm); 8 57-mm (6-pdr); 2 37-mm (1-pdr); 4 0.30-in (7.62-mm) Colt machine-guns *Crew:* 327

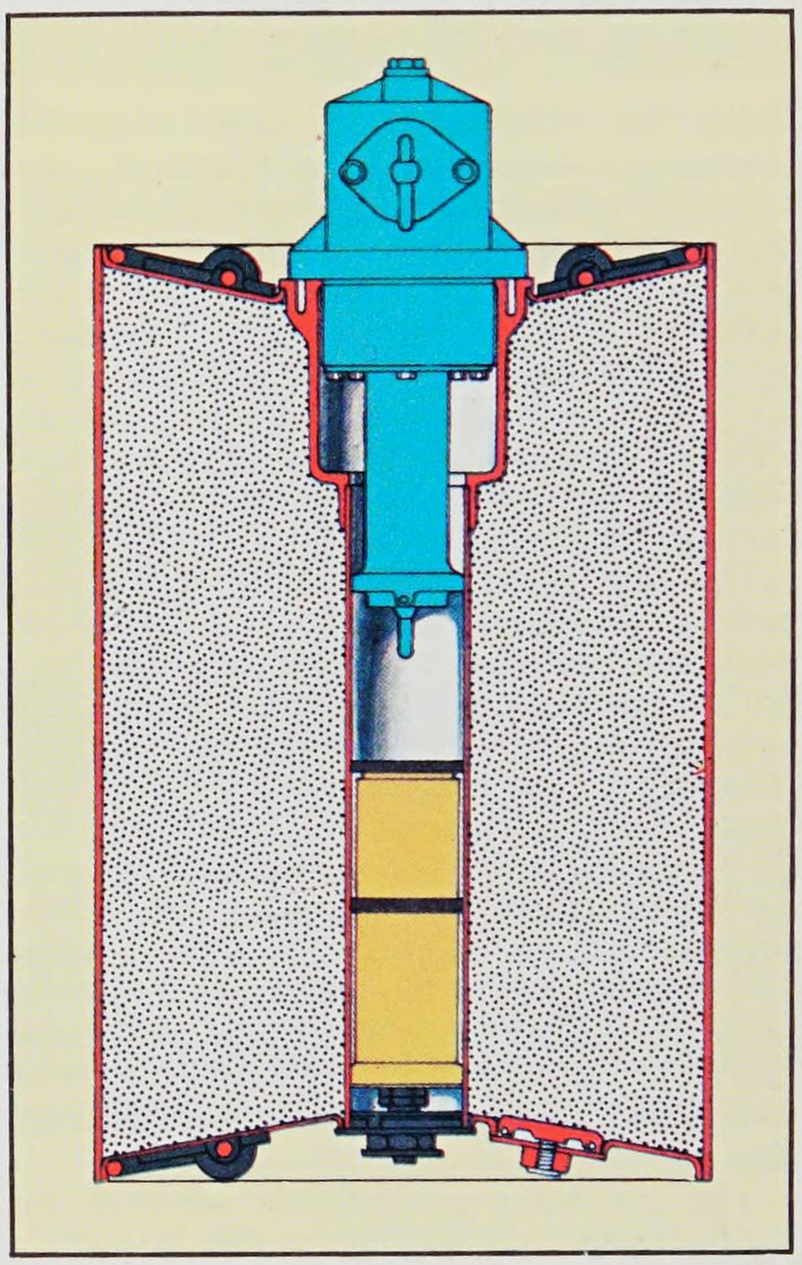
Depth-charge

Allied antisubmarine weapon. The problem of attacking submarines in the early months of the First World War was that existing methods—gunfire and ramming—only worked against a submarine in the act of submerging. Once a submarine was at periscope depth only an accidental collision was likely to sink it, as the surface warship had virtually no idea of the target's position.

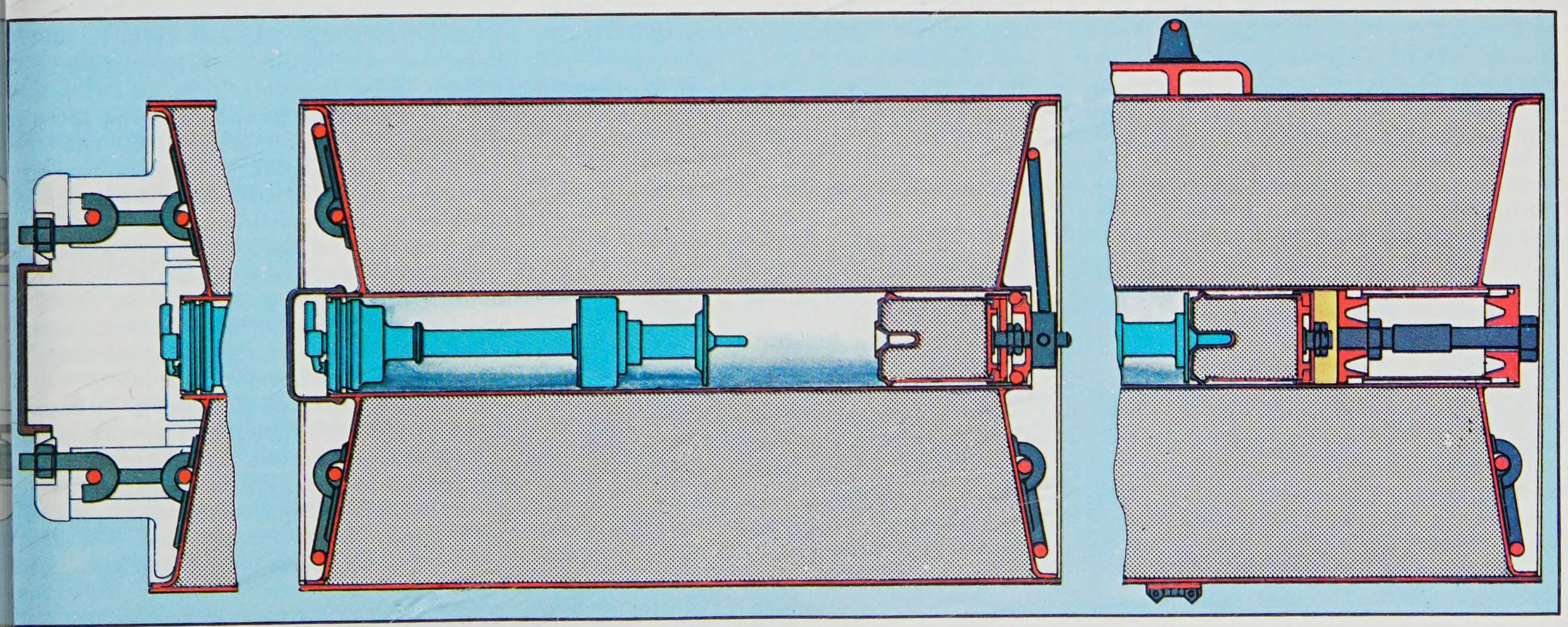
The provision of hydrophones made it possible to detect the presence of a submarine by sound, and virtually simultaneously Allied scientists produced the depth-charge. This was a hollow cylindrical canister filled with Amatol high-explosive, and actuated by a hydrostatic pistol or exploder, preset to explode at the estimated depth.

Although the lethal radius of a depth-charge was only 7.6 m (25 ft), the shock effect of 136 kg (300 lb) of explosive was sufficient to cause considerable damage to the delicate

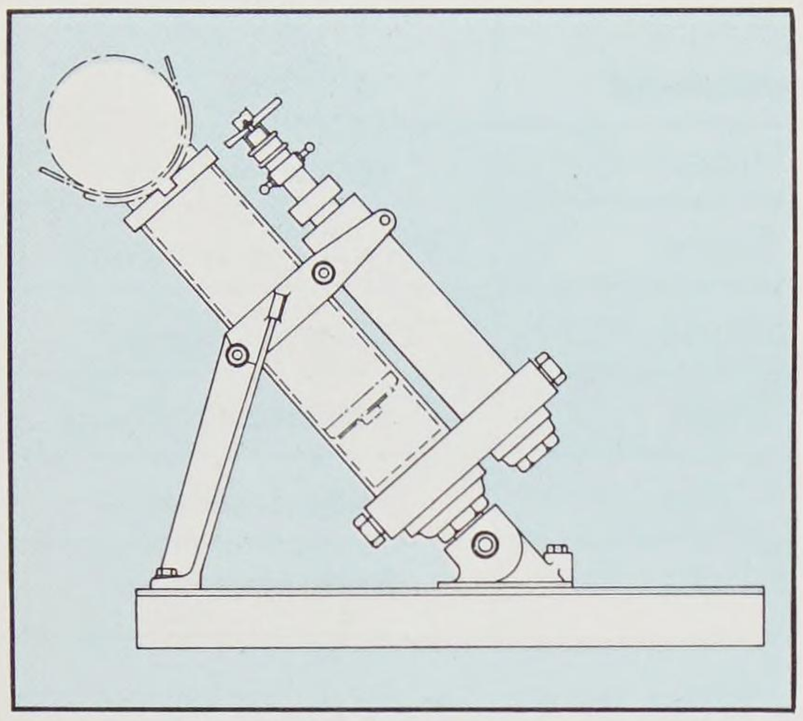
A British 'D' Type depth-charge Mk III used from 1916. It held 136 kg (300 lb) of TNT, a primer, pistol, detonator and depth adjuster



Below: **British depth-charges. The Mk VII (Heavy) had an extra weight added to assist fast sinking (left). The standard Mk VII (centre) was used throughout the Second World War. The Mk VII (Aircraft Pattern), with attachment lugs, was the first airborne depth-charge (right)**



Depth-charge



The Thornycroft depth-charge thrower. Developed during the First World War, it enabled ships to fire a pattern of depth-charges to a distance of 70 m (75 yards)

British depth-charges of the Second World War

Type	total weight (kg/lb)	charge weight (kg/lb)	length (cm/in)	diameter (cm/in)	descent rate (m/sec/ ft/sec)	comment
Mk VII	185/410	179/396	70.4/27.75	44.4/17.5	3/10	Issued to surface ships
Mk VII (aircraft)	203/448	179/396	70.4/27.75	44.4/17.5	3/10	Nose and tail added
Mk VII (heavy)	254/560	179/396	81.9/32.25	44.4/17.5	5/16.5	63.5-68 kg (140-150 lb) weight added
Mk VIII	133/295	115/255	97.7/38.5	27.9/11	2.7/8.9	Air-dropped with detachable tail

fittings of a U-Boat. Light bulbs would be shattered, rivets could be loosened, and kingston valves could be jammed. Any leakage of seawater into a submarine is dangerous, as it mixes with sulphuric acid in the batteries to form chlorine gas. Prolonged depth-charging often caused sufficient damage to force a submarine to the surface, although experienced crews could often cope with the nerve-wracking ordeal and make running repairs.

The first depth-charge issued was the D pattern in 1916. Initially, very few were available, not more than four per destroyer, but production was stepped up, and by 1918 as many as 30 were carried. It was long thought that the first successful attack with depth-charges was made in July 1916 on *UC 7* by the motor boat *Salmon*, but *UC 7* escaped on this occasion. The first 'kill' with depth-charges was on December 6, 1916, when *UC 19* was sunk in the Dover Straits by the destroyer *Llewellyn*. A week later, *Ariel* sank *UB 29* in the Channel, and during the next two years a further 25 U-Boats were sunk by this means.

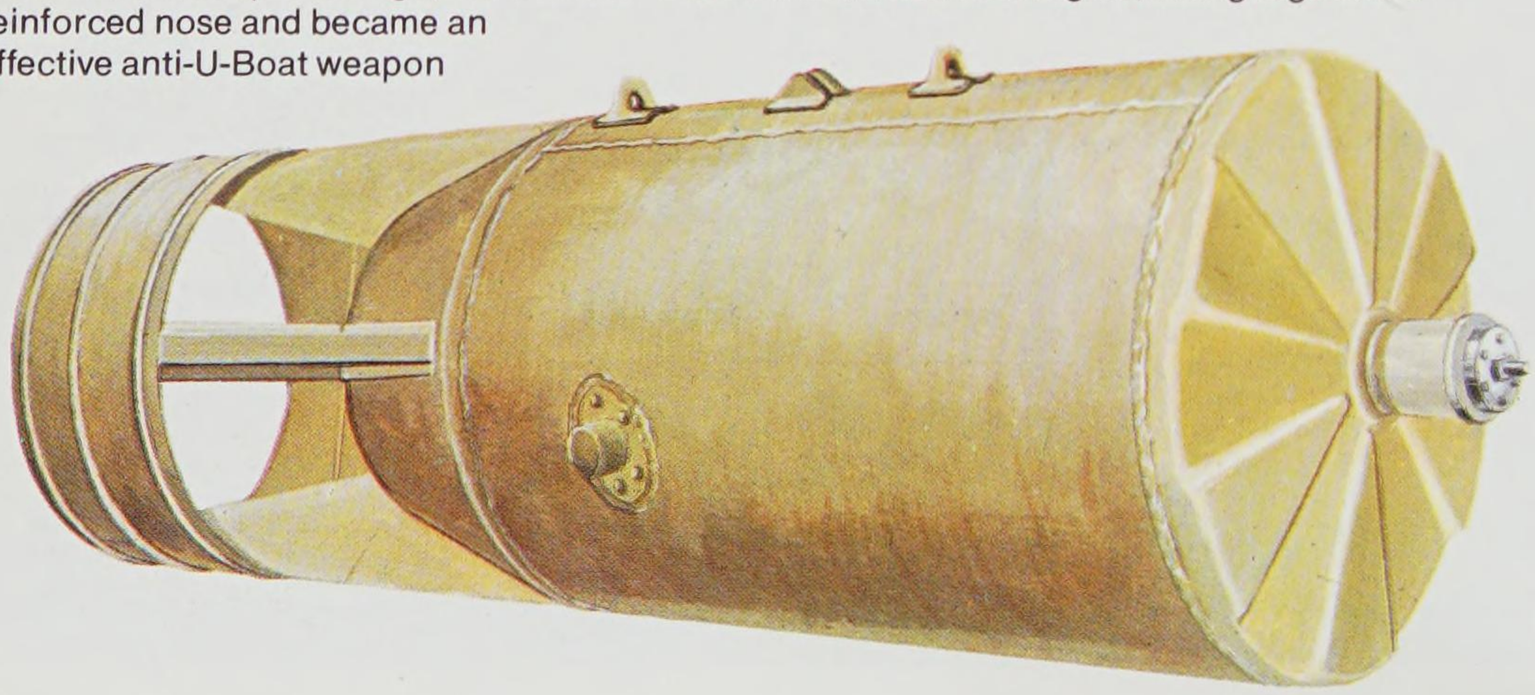
The US Navy immediately adopted the depth-charge, christening it the 'ash-can', and before long it was standard in every navy. By 1939, the Royal Navy was using the Mark VII, but in essence this depth-charge differed little from the D.III type in use in 1918, apart from a more rugged pistol and a stronger casing. A more important development was an efficient thrower, first designed by the British shipbuilding and engineering firm John I Thornycroft in 1917-18. It hurled a carrier clear of the ship, and with four throwers and a stern-chute it was possible to lay a pattern of depth-charges around the estimated position of a U-Boat.

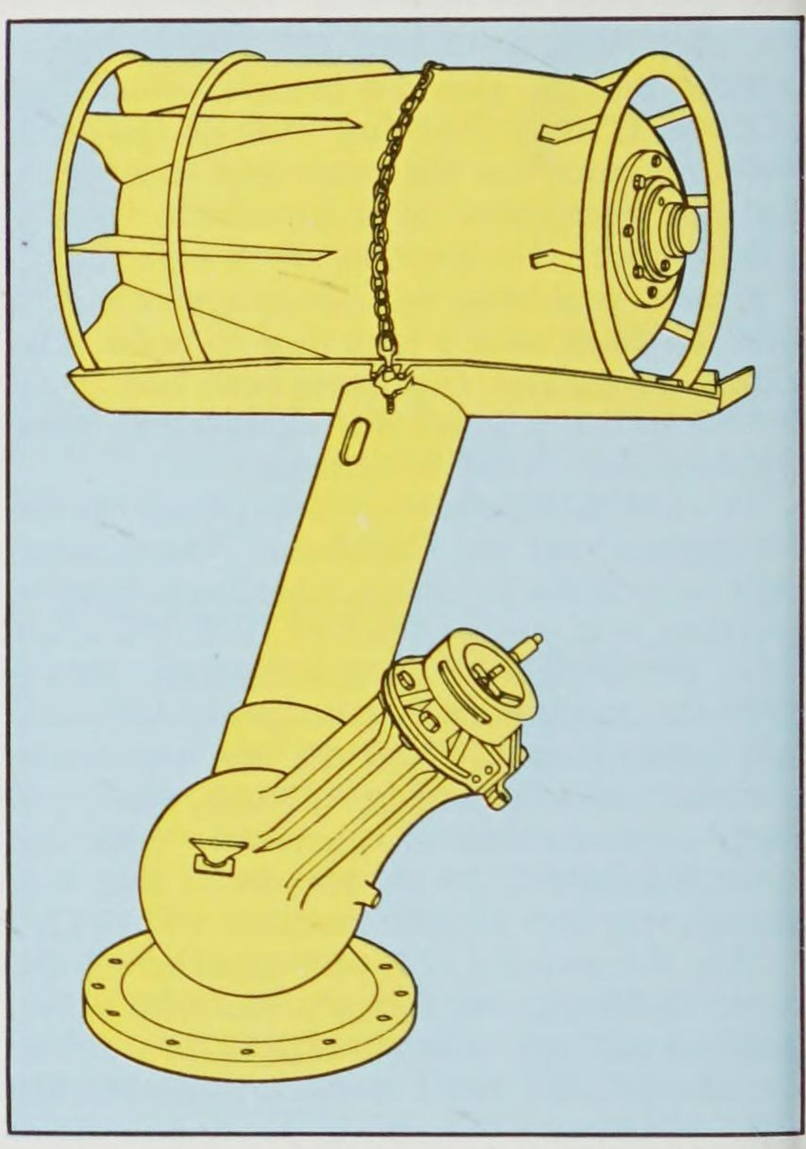
In its simplest form, the depth-charge pistol had six settings, one for each depth, from 30 to 183 m (100-600 ft), and when a key was turned by hand, water was let into one of six holes. According to the diameter of the hole, water flowed in slowly or rapidly to fill the pistol chamber, at which point a spring was released to thrust the percussion detonator against the primer.

Until 1940, it was believed that aircraft bombs would be more effective against U-Boats than depth-charges, but RAF Coastal Command found that its 113-kg (250-lb) antisubmarine bomb tended to skip upwards, and was more dangerous to the aircraft! Initially, a naval Mk VII was adapted, pending the production of a proper aerodynamically stable weapon. Another problem was encountered by surface escorts in the Atlantic, when U-boats dived below 183 m (600 ft), which was originally thought to be the maximum. This meant that the depth-charges could not be set to explode at the correct depth. A related problem was the slow rate of sinking of the Mk VII.

A temporary solution was to use 'necklaces' of three Mk VIIs. This had been proposed in 1938, and the idea was revived in January 1941. This time a 1-ton depth-charge was designed, but it was so heavy that it had to be fired like a torpedo, from a deck-mounted tube. After some teething troubles, it was issued in 1942 to the destroyers

A US airborne depth-charge, the 'ash can' was refined, fitted with flights, lifting lugs and a reinforced nose and became an effective anti-U-Boat weapon





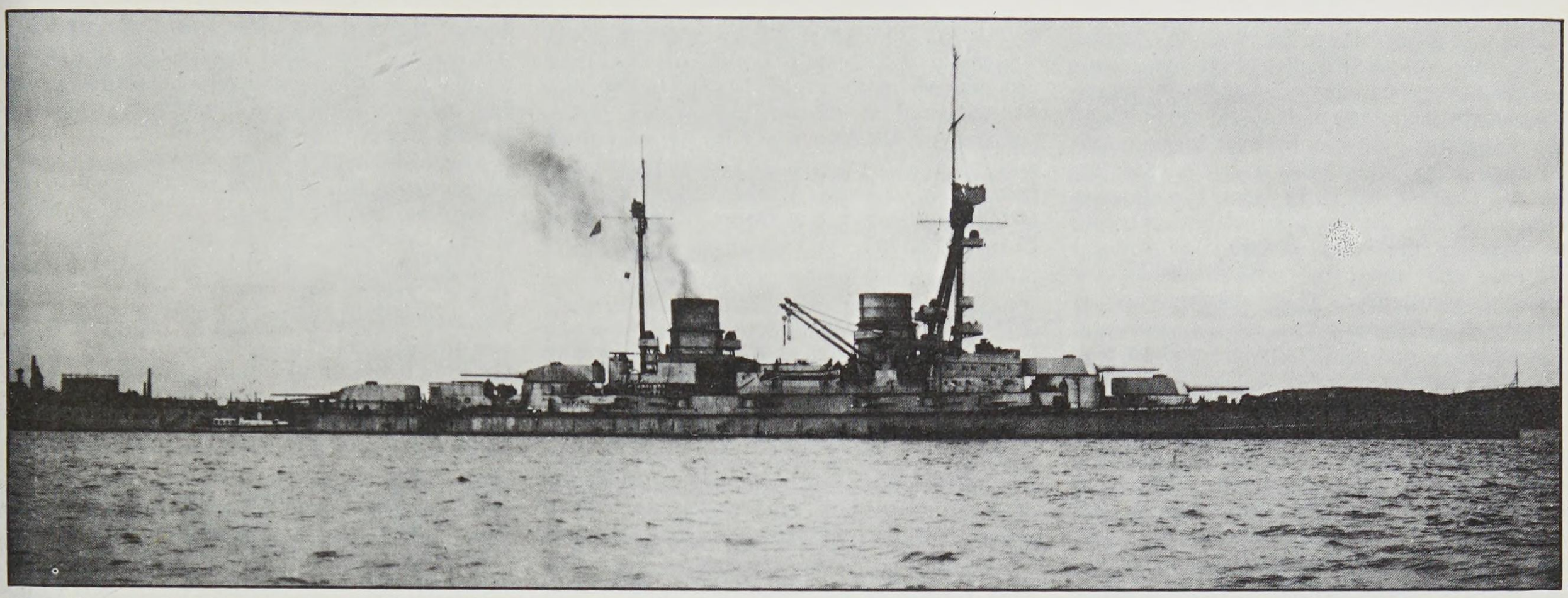
A US Navy depth-charge projector, basically a spigot mortar set to fire a pattern of charges

Ambuscade, Boadicea, Buxton, Chesterfield and *Newmarket*. Known as the Mk 10, it could be dropped at speeds of 11 knots or more, and reach targets at 274 m (900 ft).

North Atlantic escorts retained one set of triple or quadruple torpedo tubes to fire the new charge. In a three-tube ship the two left-hand tubes carried Mk 10 charges, and the right-hand tube carried a Mk 10*, a slightly modified version which sank faster. In a four-tube ship, two of each type were carried.

The total weight of each charge was 1360 kg (3000 lb), and the charge was 907 kg (2000 lb) of Minol. The minimum safe laying speed was 18 knots, to avoid the risk of blowing the stern off the escort. In 1944, the Mk 10** was produced, capable of detonating at depths down to 457 m (1500 ft), and it remained an awesome weapon until finally superseded by the deep-running acoustic torpedo. Once escort commanders learned to use it, the Mk 10** produced spectacular and frequently grisly results, and was capable of ripping a U-Boat apart.

Much thought was given to devising more



Bundesarchiv

The German battlescruiser *Derfflinger* after alterations in 1916 which included the substitution of a tripod for her original pole mast

destructive patterns of depth-charges, and in the Battle of the Atlantic, destroyers could eventually drop up to 14 depth-charges in a set pattern, aimed at producing a three-dimensional spread to explode around the U-Boat. Rapid reloading was also devised in order to make continuous depth-charging possible. Redesign of the shape, improved sinking and Minol, a more powerful explosive, gave more destructive effect.

The US Navy Mk 9 was similar to the British Mk VII. In June 1942, the Mk VIII aerial depth-charge was issued to RAF Coastal Command, with a fuze capable of setting to detonate within 7.6 m (25 ft) of the surface (unlike the aerial adaptation of the Mk VII) and this caused a dramatic increase in 'kills'.

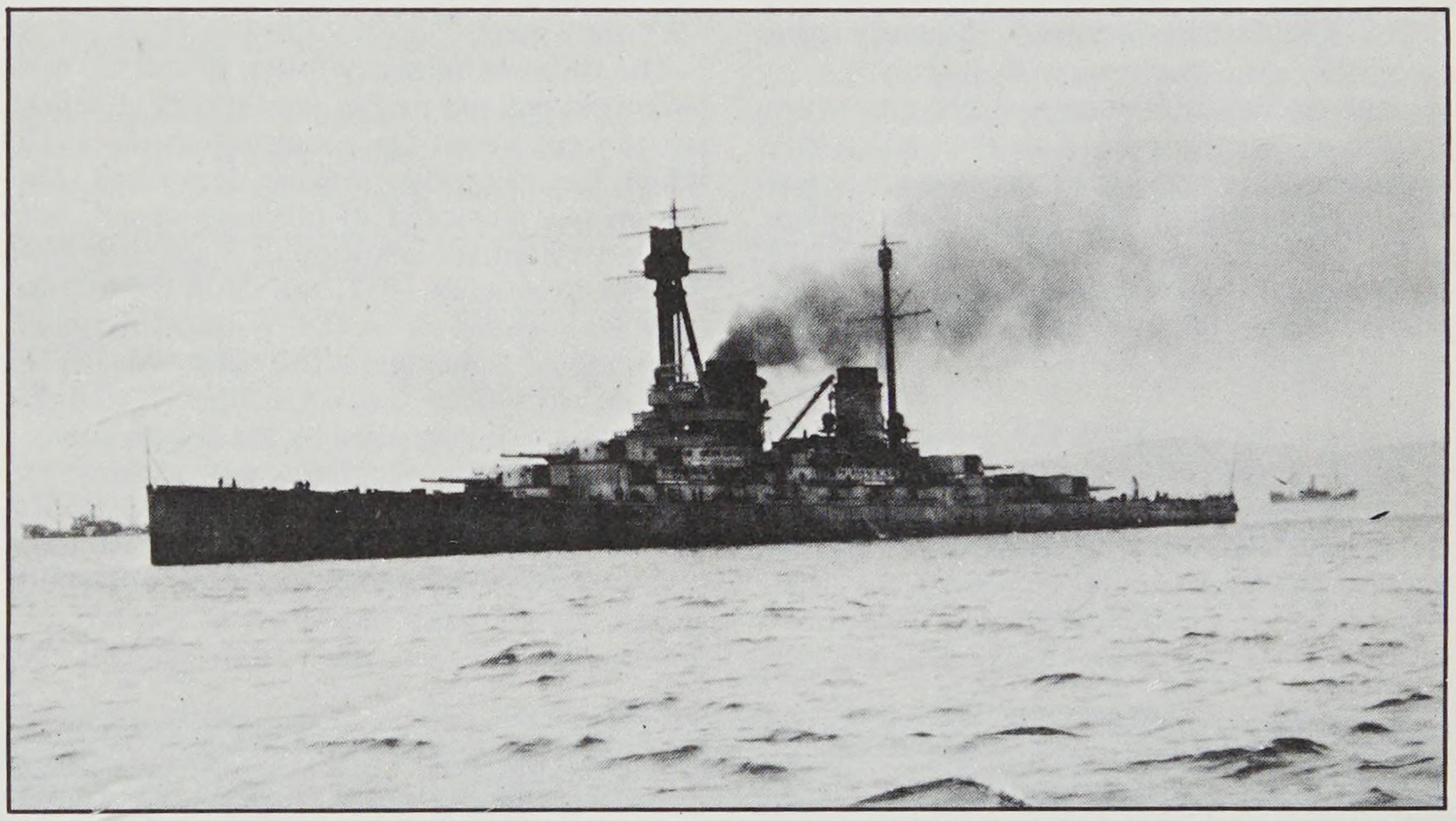
The development of ahead-firing weapons, first the Hedgehog and Mousetrap, and then Squid and Limbo made the simple depth-charge redundant, but in the form of a finned aerodynamic bomb with a time-fuze the depth-charge was still in use in the late 1970s. Two forms are used, a mortar-bomb as in Squid and Limbo or a 375-mm (14.8-in) rocket-propelled bomb developed by Bofors. The latter type is also used by Soviet antisubmarine escorts, in 250-mm (9.8-in) and 300-mm (11.8-in) versions.

The final development is the nuclear depth-charge, which follows the principle of the old 1-ton depth-charge, in providing a very heavy detonation at great depth. An air-dropped weapon called Betty was developed in the US, and it is reported that Asroc has a similar type of warhead as an alternative to the normal Mk 46 homing torpedo.

Derfflinger

German battlecruiser class, built 1912-17. In the summer of 1911, plans were drawn up for a class of ships to succeed the *Moltke* Class, with a scale of armour closer to battleships, and 12-in (305-mm) guns, as in the contemporary *Konig* Class battleships.

The ships which resulted were a break with previous practice, and were 'capital ships' in the true sense, as close to the concept of the fast battleship as their British contemporaries, the *Queen Elizabeth* Class. The long hull was flush-decked, with lower freeboard and only four 12-in (305-mm) turrets to compensate for the extra weight of armour. Also for the first time, some of the boilers were oil-burning, giving trial speeds of $25\frac{1}{2}$-$26\frac{1}{2}$ knots.



IWM

SMS *Hindenburg*, sister ship of the *Derfflinger*, at Scapa Flow after the First World War

Name	launched	builder
Derfflinger	7/1913	Blohm & Voss, Hamburg
Lützow	11/1913	Schichau, Danzig
Hindenburg	8/1915	Wilhelmshaven dockyard

The appearance of the ships was impressive, with a long forecastle and two big, widely-spaced funnels. The *Derfflinger* had two half-cased funnels, the foremost slightly higher than the second; the *Lützow* had the casing carried up to the top of the forefunnel, while the *Hindenburg* had the casings carried up much higher, and had both funnels of equal height. When completed the *Derfflinger* and *Lützow* had two light pole masts, but after the battle of the Skagerrak (Jutland) in 1916 the *Derfflinger* was given a heavy tripod. The *Hindenburg* was completed with a tripod, but in her case the trailing legs were closer together. All three ships were armed with eight single 88-mm (3.5-in) antiaircraft guns in shields, mounted in two groups forward and aft.

SMS *Derfflinger* joined the German high seas fleet in September 1914 and took part in the Scarborough Raid, the battle of the Dogger Bank on January 24, 1915, and the other actions involving the German battlecruisers. At the battle of the Skagerrak on May 31, 1916, she was part of the 1st Scouting Group under Admiral Hipper, and was heavily damaged by a total of 17 hits. Despite having 3000 tons of water aboard, she limped back to Wilhelmshaven and took four months to repair. She was scuttled at Scapa Flow on June 21, 1919, and was not raised until 1934. The hull was towed bottom uppermost to Rosyth and was not finally broken up until 1948.

The *Lützow* joined the fleet in August 1915, but serious troubles with her steam turbines meant that she was not finally operational until the spring of 1916. At the battle of the Skagerrak, she was hit by a torpedo and 24 shells, and took 7500 tons of water on board. Despite warnings from her damage control officer, the captain insisted on trying to maintain the speed ordered by Admiral Hipper, and under the colossal strain her bulkheads collapsed. There was no hope of getting the wallowing hulk back to port and the torpedo boat *G.38* was ordered to sink her with two torpedoes.

The *Hindenburg* missed the Skagerrak battle and growing problems with shortages of labour and material meant that she was not completed until May 1917. She joined the other ships of the high seas fleet in the surrender after the Armistice, and was scuttled at Scapa Flow. Despite frantic efforts to beach her she sank upright, with her massive upperworks above the water, and was not raised until July 1930.

The *Hindenburg* differed internally from the earlier pair of ships, with slightly thicker armour on the barbettes, and her machinery producing more power, giving her half a knot more speed. She and the *Lützow* were armed with the new 60-cm (23.6-in) torpedo in place of the older 50-cm (19.7-in). It weighed 2000 kg (4410 lb), had a 249-kg (550-lb) warhead and travelled 1888 m (2065 yards) at a speed of 28 knots.

Displacement: 26 180-26 513 tons (normal), 30 707-31 002 tons (full load) *Length:* 210 m (689 ft) wl *Beam:* 28.95 m (95 ft) *Draught:* 8.38 m (27 ft 6 in) *Machinery:* 4-shaft steam turbines, 63 000 shp=26.5 knots (*Hindenburg* 72 000 shp= 27 knots) *Protection:* 300-152 mm (11.81-6 in) belt; 51-25 mm (2-1 in) decks; 270 mm (10.6 in) turrets; 350 mm (13.8 in) conning tower *Armament:* 8 305-mm (12-in)/50-cal (4×2); 12 150-mm (5.9-in)/45-cal QF (12×1); (*Hindenburg* 14 150-mm); 8 88-mm (3.5-in) QF (8×1), replaced by 4/8 88-mm (3.5-in) AA mountings during 1916-17; 4 50-cm (19.7-in) torpedo tubes (submerged, 2 beam, 1 bow, 1 stern), *Lützow* and *Hindenburg* had 4 60-cm (23.6-in) tubes *Crew:* 1112-1182

De Ruyter

Dutch light cruiser, built 1933-1936. The building of this one ship caused an extraordinary controversy in the Netherlands, with arguments raging from 1930, as soon as the decision to build the new cruiser was announced. The main argument was over the choice of six 6-in (152-mm) guns; many people thought that eight 6-in (152-mm) guns was a more suitable armament. There was even a prize essay competition, and two of the three candidates plumped for a ship like the British cruiser *York,* with six 8-in (203-mm) guns.

The defence ministry stuck to the six 6-in (152-mm) gunned design, and in 1930 the first funds were voted for construction. In 1932, when the financial position improved, the design was enlarged to increase speed, and this permitted the addition of a seventh gun. At last in August 1932, the contract for the ship was awarded to the Wilton-Fijenoord shipyard at Schiedam. The ship was to be built in a dry dock, not on a slipway, and the guns were to be supplied by the shipbuilders.

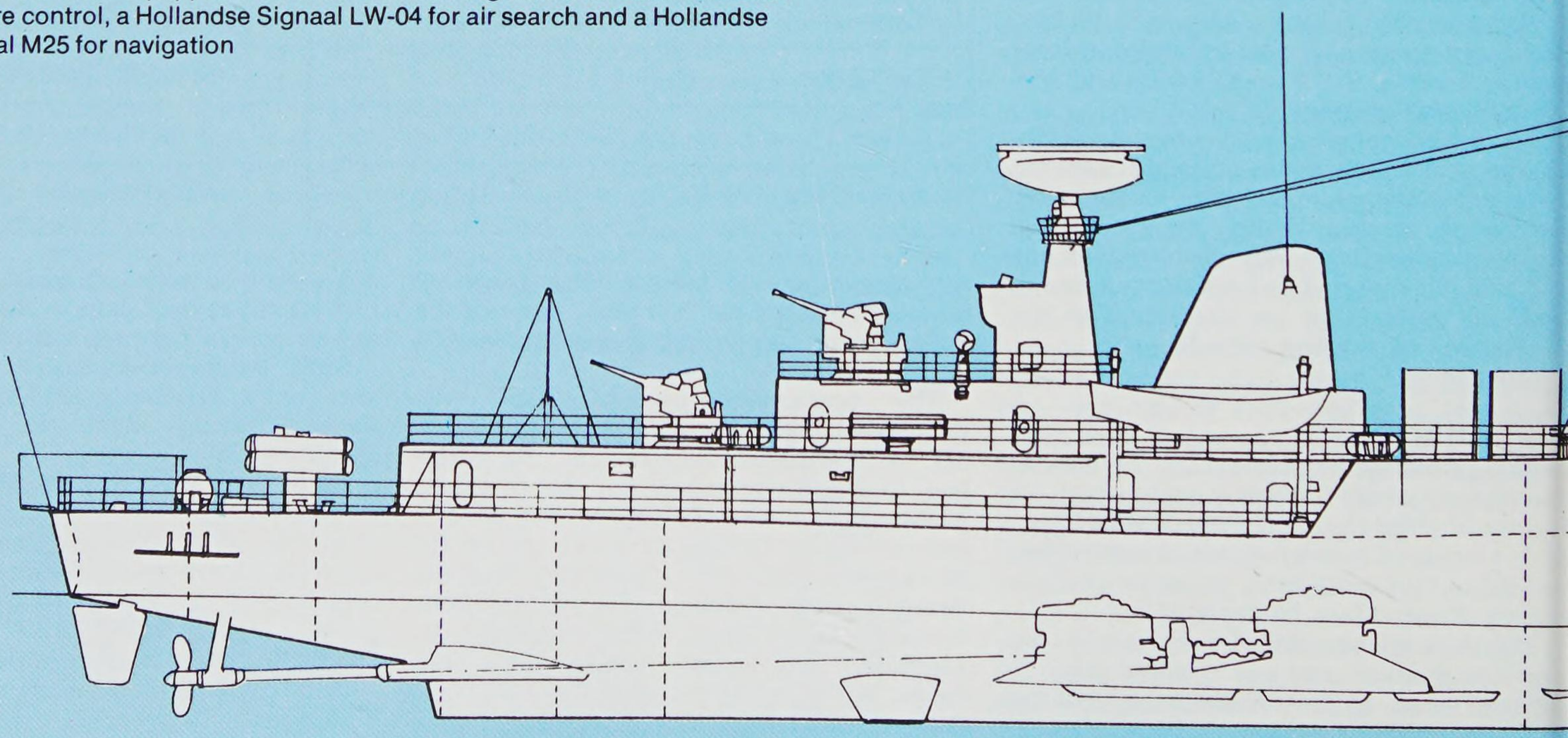
The *de Ruyter* was launched on May 11, 1935, and commissioned in October 1936. In 1937 she left for the Far East, and in October that year she relieved the *Sumatra* as flagship of the East Indies squadron at Soerabaya. When the Netherlands declared war on Japan, the morning after Pearl Harbor, she put to sea with four destroyers to guard against a possible Japanese incursion into the Indian Ocean, and later she helped to convoy British shipping to Singapore.

The last chapter in *de Ruyter*'s short but adventurous life began in mid-January 1942, when she became flagship of Rear Admiral Karel Doorman, commander of the new ABDA (American-British-Dutch-Australian) striking force. She was in action several times during the following weeks, as Japanese aircraft and ships advanced southwards. On the afternoon of February 26 she and an Allied force of cruisers met a Japanese task force in the battle of the Java Sea. At 2334 hours *de Ruyter* was torpedoed in action with the Japanese heavy cruisers *Nachi* and *Haguro.* Two hours later she sank, with the loss of Admiral Doorman and nearly 350 of her crew. Many lives were lost by exploding AA ammunition and burning oil.

The armament finally comprised six 150-mm (5.9-in) guns in Mk 9 twin turret-mountings, and one 150-mm (5.9-in) gun in a Mk 10 single open shield, all on the centreline. The Netherlands navy was considerably ahead of other navies in the design of light antiaircraft mountings, and the Hazemeyer company had designed the world's first tri-axially stabilized mounting for the Bofors 40-mm (1.57-in) gun, with its own mechanical computer 'on board'. Five twin Mk 3 mountings were provided as a secondary armament, all on a platform at the after end of the superstructure. There were also four twin mountings for 12.7-mm (0.5-in) machine-guns, two on the navigating bridge and two on a platform around the conning tower.

The ship carried two Fokker C XI W floatplanes and a catapult designed by Hein-

The Spanish *Descubierta*, lead ship of the 'F 30' Class frigates, and similar to the Portuguese *Joaõ Coutinho* Class built by Bazán, but with modifications to the armament and engines. They are reported to be designed to carry 30 marines, and are equipped with one Hollandse Signaal M22 radar for search and fire control, a Hollandse Signaal LW-04 for air search and a Hollandse Signaal M25 for navigation



kel Flugzeugwerke. Both aircraft were landed before the Java Sea action, partly to reduce the fire-risk and partly because shore-based aircraft were available.

Displacement: 6442 tons (light), 7548 tons (full load) *Length:* 170.92 m (560 ft 9 in) oa *Beam:* 15.7 m (51 ft 6 in) *Draught:* 5.87 m (19 ft 3 in) maximum *Protection:* 51-25 mm (2-1 in) belt; 25 mm (1 in) deck; 25 mm (1 in) turrets *Armament:* 7 150-mm (5.9-in)/50-cal (3×2, 1×1); 10 40-mm (1.57-in)/60-cal AA (5×2); 8 12.7-mm (0.5-in) machine-guns (4×2) *Aircraft:* 2 floatplanes, 1 catapult *Crew:* 435

Descartes

French protected cruiser class. Built 1892-1900, these rakish-looking cruisers were intended for detached work on the trade routes, and had only medium-calibre guns. They cost about £350 000 each, and remained good steamers for most of their lives.

The class was designed by Louis de Bussy, the designer of the highly successful *Dupuy de Lôme*. There were considerable differences in appearance, as French builders had wide latitude. *Descartes* and *Pascal* had upright funnels, whereas the others had a noticeable rake, and each one had distinctive features. They were sheathed and coppered for foreign service, and all made 19-20 knots on a four-hour trial.

Three were stricken in 1910, the *Protet* being sold in October 1910 and scrapped at Hamburg, the *Catinat* sold at Rochefort in 1911 and the *Pascal* sold at Toulon the same year. The *Descartes*, however, survived to serve in the First World War. In August 1914, she was in the Antilles, and on September 23, she was damaged in collision with a Spanish merchant ship off St Lucia. After repair at Fort de France, she again collided with a ship, this time the British *Strathmore*. Apart from a spell at Port-au-Prince in 1915, protecting French interests against unrest, she remained in the West Indies without incident until 1917. Then she returned to Lorient, where she was disarmed; her 164.7-mm (6.4-in) guns were given to the Army and her 100-mm (3.9-in) and 47-mm (1.8-in) guns went into antisubmarine escorts.

The ship was stricken in May 1920 and sold for scrapping a year later.

Displacement: 4000 tonnes (normal) *Length:* 99 m (324 ft 9 in) pp *Beam:* 13 m (42 ft 8 in) *Draught:* 6.5 m (21 ft 4 in) *Machinery:* 2-shaft triple-expansion, 8500 ihp= 19 knots *Protection:* 50-20 mm (1-¾ in) deck; 54 mm (2.13 in) gun-shields *Armament:* 4 164.7-mm (6.4-in)/45-cal Model 1891 (4×1); 10 100-mm (3.9-in)/45-cal Model 1885 (10×1); 8 47-mm (1.8-in)/50-cal Model 1885 (8×1); 2 35.6-cm (14-in) torpedo tubes (above water, beam) *Crew:* 421

Name	launched	builder
Descartes	9/1894	Ch de la Loire, Nantes
Pascal	9/1895	Toulon Arsenal
Catinat	10/1896	Granville
Protet	7/1898	F et Ch de Bordeaux

Descubierta

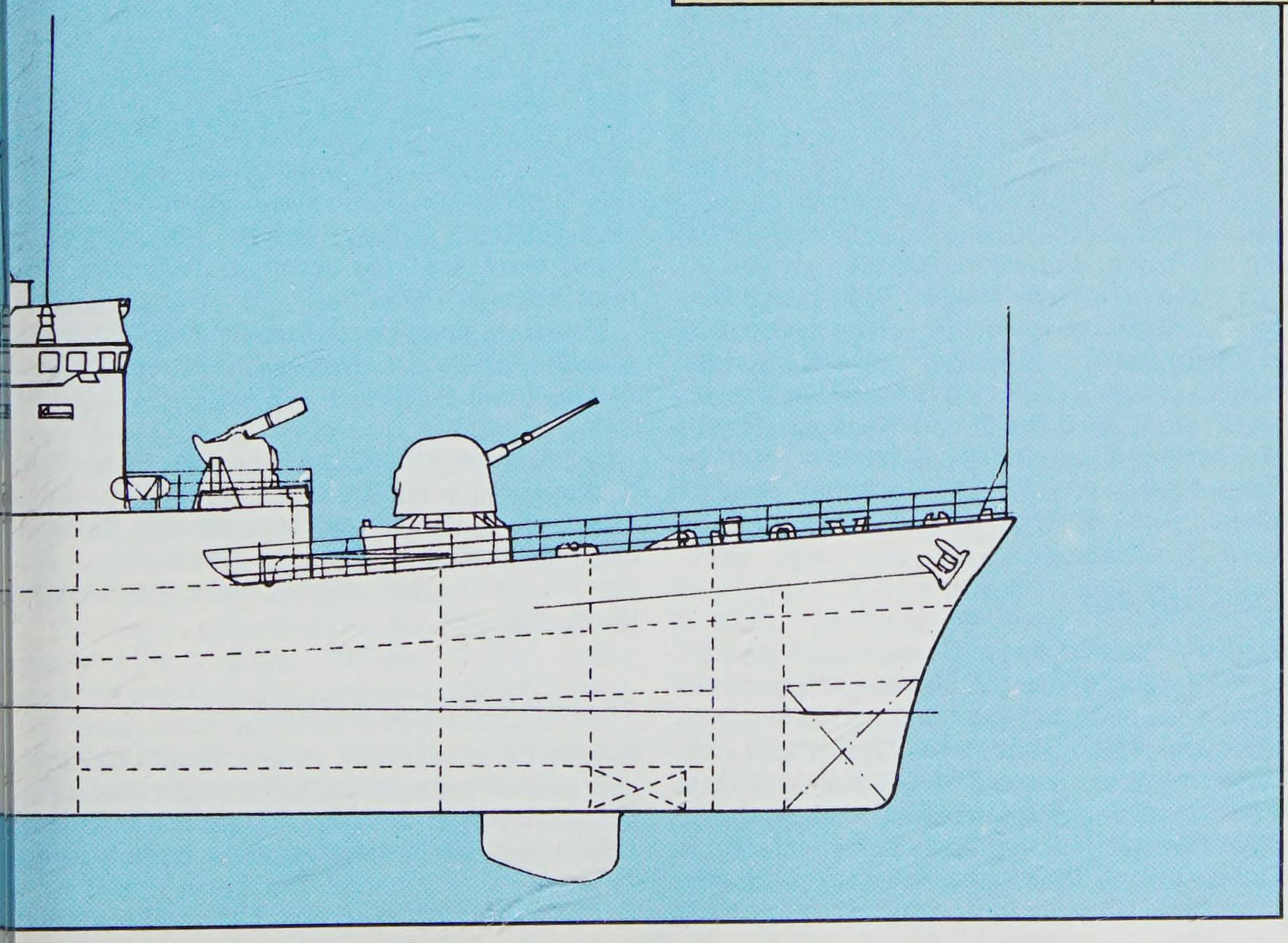
Spanish frigate class. Under the 5-Year Naval Programme of 1974 the Spanish navy was voted funds for the construction of eight 1270-tonne frigates to replace the elderly sloops of the *Pizarro* and *Atrevida* Classes dating from 1944. The design chosen was an adaptation of the *Joaõ Coutinho* Class built in German and Spanish yards for the Portuguese in 1970-75, with a much heavier and more effective armament.

The hull is flush-decked, with a transom stern, and subdivided into 12 compartments. The armament comprises an OTO-Melara 76-mm (3-in) dual-purpose gun forward, two single Breda Bofors 40-mm (1.57-in) guns aft, a NATO Sea Sparrow launcher on the quarterdeck, antisubmarine torpedo tubes and a twin Bofors 375-mm (14.75-in) antisubmarine rocket-launcher in 'B' position. There is also provision for two 12-barrelled 20-mm (0.79-in) Meroka Close-In Weapon Systems (CIWS). This home-grown equivalent of the US Navy's Vulcan Phalanx system uses two rows of six barrels in a non-rotating mounting, with its own on-board radar control. The 20-mm (0.79-in)/120-cal gun is based on the Oerlikon 5TG, and is designed and manufactured by Empresa Naçional Bazán, the shipyard and arsenal at Cadiz.

There is also provision for two McDonnell Douglas Harpoon surface missile systems, which will make them the first Spanish warships so armed. The launchers angled at 90° to the centreline. Sixteen reloads are carried for the Sea Sparrow launcher.

The outfit of sensors is elaborate for the size of ship: Hollandse Signaalapparaten DA-05 E/F-bank surveillance radar at the head of the mainmast, HSA WM-25 I/J-band search and target-tracking radar at the head of the foremast, HSA WO-06 X-bank tactical radar on the foremast, and an ELT-715 active ECM and passive ESM outfit, also on the foremast. A Raytheon DE-1160B (also known as the AN/SWS-56) sonar set is mounted in the hull, and Aerojet AN/SLQ-25 antitorpedo ECM gear is provided.

Pendant no and name	launched	builder
F.31 *Descubierta*	7/1975	Bazán, Cartagena
F.32 *Diana*	1/1976	Bazán, Cartagena
F.33 *Infanta Elena*	9/1976	Bazán, Cartagena
F.34 *Infanta Cristina*	building	Bazán, Cartagena
F.35 unnamed	building	Bazán, El Ferrol
F.36 unnamed	building	Bazán, El Ferrol
F.37 unnamed	building	Bazán, El Ferrol
F.38 unnamed	building	Bazán, El Ferrol



Des Moines

The propulsion units are four MTU 16-cylinder diesels, built by Bazán under licence, giving a maximum speed of 27 knots. The exhausts are led to a split uptake, angled in a 'Y' shape to carry the fumes clear of the foremast and aerials.

The last four vessels were ordered on May 23, 1976, and will complete in 1979-80.

Displacement: 1270 tonnes (standard), 1520 tonnes (full load) *Length:* 88.88 m (291 ft 8 in) oa *Beam:* 10.4 m (34 ft 1 in) *Draught:* 6.2 m (12 ft 2 in) max *Machinery:* 2-shaft diesels, 16 000 bhp=27 knots *Armament:* 1 76-mm (3-in)/62-cal DP; 2 40-mm (1.57-in)/70-cal AA (2×1); 2 Harpoon SSMs (to be installed); 1 8-cell NATO Sea Sparrow SAM; 6 12.75-in (32.4-cm)/Mk 32 A/S torpedo tubes (2×3); 2 Meroka CIWS (to be installed) *Crew:* 100

Des Moines

US heavy cruiser class, built 1945-49. This was the last group of heavy cruisers ordered for the US Navy during the Second World War, and marks the ultimate in size and power reached by the cruiser-type.

Only two of the class, *CA.134* and *CA.139*, were laid down before the end of the war. Four units, *CA.150-153*, were cancelled in March 1945 without being laid down, another four, *CA.141-143* and *CA.149* were cancelled in August, but two, *CA.140* and *CA.148* were laid down in October 1945. The name *Dallas* had been allocated to *CA.150* and when that unit was cancelled it was given to *CA.140*, but she too was finally cancelled and the material on the slipway was broken up.

The basis of the design was the single-funnelled development of the *Baltimore* Class, known as the *Oregon City* Class, but the opportunity was taken to add 18 m (60 ft) to the length and 1.7 m (5 ft 6 in) to the beam to permit automatic loading gear for the 8-in (203-mm) guns, as well as extending the waterline belt armour to include the barbettes of the 8-in (203-mm) turrets. Automatic loading was a slight misnomer, in that all 8-in (203-mm) guns of that vintage had power-loading but the rate of fire was speeded up considerably by providing cased charges. The rate of fire of the new Mk XVI was about 10 rounds per minute, as against about 2½ rounds per minute for the Mk XV and older marks of 8-in (203-mm), which meant that the *Des Moines* Class could fire in the space of a minute a total of 15 tons of explosive at a range of 22.5 km (14 miles).

The secondary and tertiary armament reflected all the lessons of the Pacific War. The standard 'lozenge' disposition of twelve 5-in (127-mm)/38-cal dual-purpose guns was retained, but 12 of the new 3-in (76-mm)/50-cal twin automatic weapons were mounted in place of the quadruple 40-mm (1.57-in) Bofors, although a further 12 of the less effective 20-mm (0.79-in) Oerlikons were also provided in single mountings. These light AA guns were removed from all three ships soon after completion.

Since 1949 the number of 3-in (76-mm) twins has been reduced to make way for increased radar, communications and even accommodation; by 1973 the *Newport News* had lost her last two mountings. All three ships were designed to have floatplanes, two catapults and a handling crane on the stern,

No and name	launched	builder
CA.134 *Des Moines*	9/1946	Bethlehem, Quincy, Mass
CA.139 *Salem*	3/1947	Bethlehem, Quincy, Mass
CA.140 *Dallas*	—	Bethlehem, Quincy, Mass
CA.148 *Newport News*	3/1947	Newport News Shipbuilding

but only the *Des Moines* had them for a while. In all three the space was used to handle boats and later helicopters.

As a result of the slowing down of construction after the end of hostilities the *Des Moines* did not commission until November 1948, and *Newport News* and *Salem* joined the Fleet in January and May 1949 respectively. For many years all three were active, and the *Salem* played the part of the *Admiral Graf Spee* in the film 'The Battle of the River Plate' in the 1950s.

The *Newport News* was the last of the three to remain active. Since 1949 she has been the flagship of the 2nd Fleet in the Atlantic. On October 9, 1967 she fired her guns in anger for the first time, in Operation 'Seadragon' off the coast of Vietnam. When she left the 'gun line' in April 1968 she had fired over 59 000 rounds of ammunition. On October 1, 1972, during a third tour of duty, she suffered a serious explosion in 'B' or No 2 turret, when a shell burst prematurely in the centre barrel. The barrel was completely detached from the turret, and was supported only by its liner; 20 men were killed and 36 injured, many of them by inhaling the smoke and fumes which engulfed the forward part of the ship.

In view of the age of the ship, and the need to keep her on the 'gun line', her defective gun was not replaced when she was repaired at Subic Bay in the Philippines. In fact the whole turret was wrecked by the explosion, and was no longer capable of firing. She was decommissioned on June 27, 1975, the last all-gun armed cruiser in the US Navy in service.

See also *Baltimore, Oregon City.*

Displacement: 17 000 tons (standard), 21 500 tons (full load) *Length:* 218.34 m (716 ft 3 in) oa *Beam:* 23.24 m (76 ft 3 in) *Draught:* 7.92 m (26 ft) *Machinery:* 4-shaft geared steam turbines, 1200 shp=33 knots *Protection:* 203-152-mm (8-6 in) belt; 152 mm (6 in) bulkheads; 76-51 mm (3-2 in) decks; 152 mm (6 in) turrets and barbettes; 203 mm (8 in) conning tower *Armament:* 9 8-in (203-mm)/55-cal Mk XVL (3×3); 12 5-in (127-mm)/38-cal DP (6×2); 24 3-in (76-mm)/50-cal AA (12×2); 12 20-mm (0.79-in) AA (12×1), removed 1948-49 *Crew:* 1860 (wartime) 271 in *Newport News* as Atlantic Fleet flagship

Desperate

British destroyer class. These ships were part of the large number of 30-knot, turtle back, torpedo-boat destroyers constructed between 1894 and 1900. When, in 1913, these '30-knotters' were reclassified according to their number of funnels, the *Desperate* and her sisters, which had two funnels, became the D Class. In fact, they were the nearest thing to a genuine class in the entire group as they were all constructed by Thornycroft and therefore incorporated similar features of detailed design. However, they did differ to a certain extent, with displacements ranging from 310 to 355 tons and slight variations in dimensions. Essentially they were faster versions of the Thornycroft 27-knot design and the first six had the sloping stern typical of the earlier vessels. The last four however, *Cygnet, Cynthia, Coquette* and *Stag*, had the more usual vertical stern. On trials all just exceeded the designed speed of 30 knots with horse power varying from 5542 *(Coquette)* to 6109 *(Ariel).*

The peacetime service of the class was mainly in the Mediterranean where one, the *Ariel*, was lost. On April 19, 1907, while on night exercises she made a mock attack on Malta harbour, but missed the entrance, ran straight into the breakwater and sank. Fortunately, only one of the crew was lost. The *Fame* served on the China Station from completion until sold for scrap at Hong Kong in 1921. She gave some truth to her name when, on June 19, 1900, with the destroyer *Whiting*, she captured four Chinese destroyers in the Peiho river during the bombardment of the Taku Forts. At the time she was commanded by Lieutenant Roger Keyes who subsequently became an Admiral of the Fleet.

The remainder of the class served in home waters during 1914-18, with the exception of *Foam* which was sold for scrap in 1914. The *Angler* and *Desperate* were attached to the Portsmouth local defence flotilla, the *Coquette, Cygnet* and *Cynthia* to the Noré local defence flotilla, and the *Mallard* and *Stag* to the patrol flotillas. The *Coquette* was mined and sunk off the east coast on March 7, 1916. Except for those based at Portsmouth, all were fitted with a 6-pdr AA gun during 1915-16 and several were equipped with depth charges during 1917-18. The *Stag* and *Fame* were sold for scrap in 1921 and the remainder in 1920.

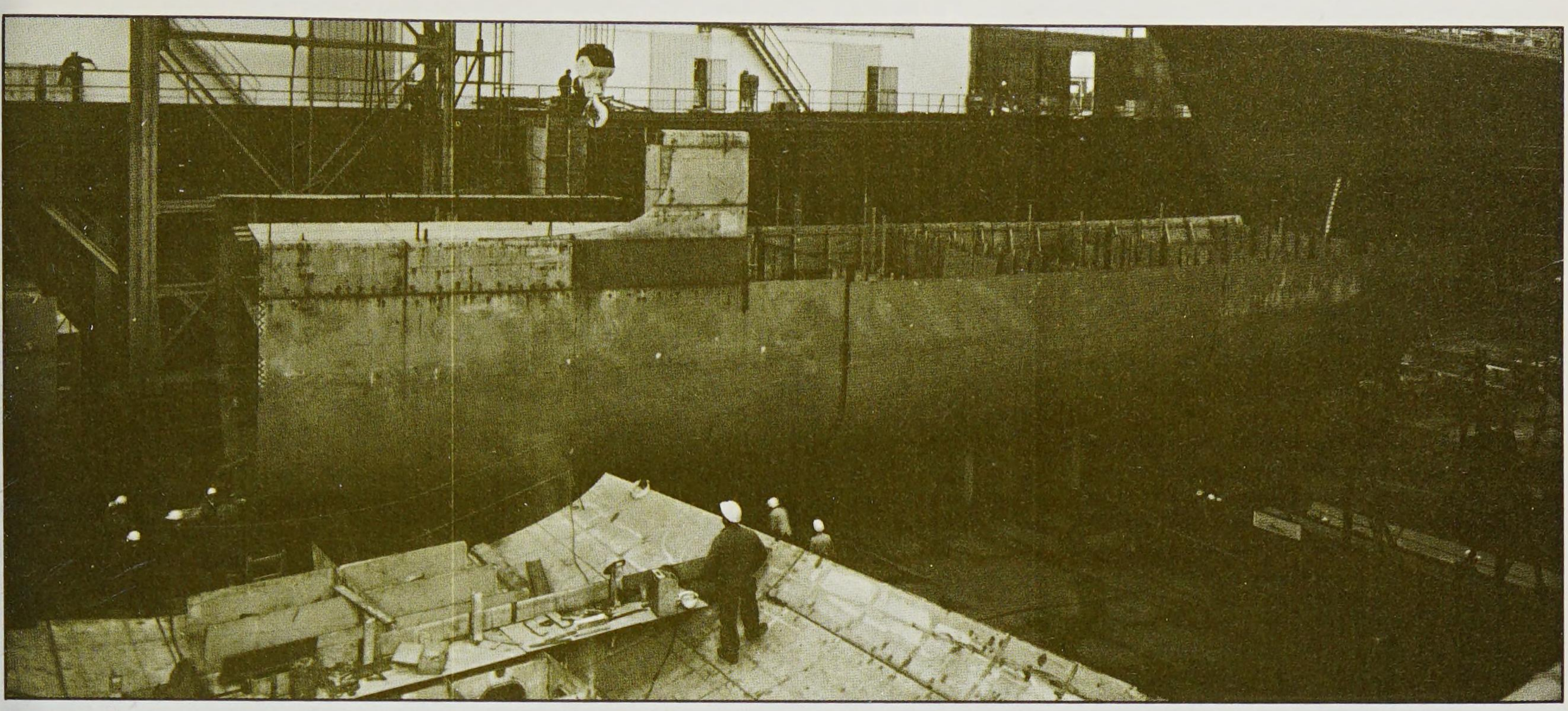
The class comprised *Angler, Ariel, Cygnet, Cynthia, Coquette, Desperate, Fame, Foam, Mallard* and *Stag.*

Displacement: 310-355 tons *Length:* 64 m (210 ft) *Beam:* 5.9 m (19 ft 6 in) *Draught:* 2.1 m (7 ft) *Machinery:* 2-shaft triple-expansion steam engines, 5800 ihp=30 knots *Armament:* 1 12-pdr; 5 6-pdr (5×1); 2 18-in (46-cm) torpedo tubes (2×1) *Crew:* 63

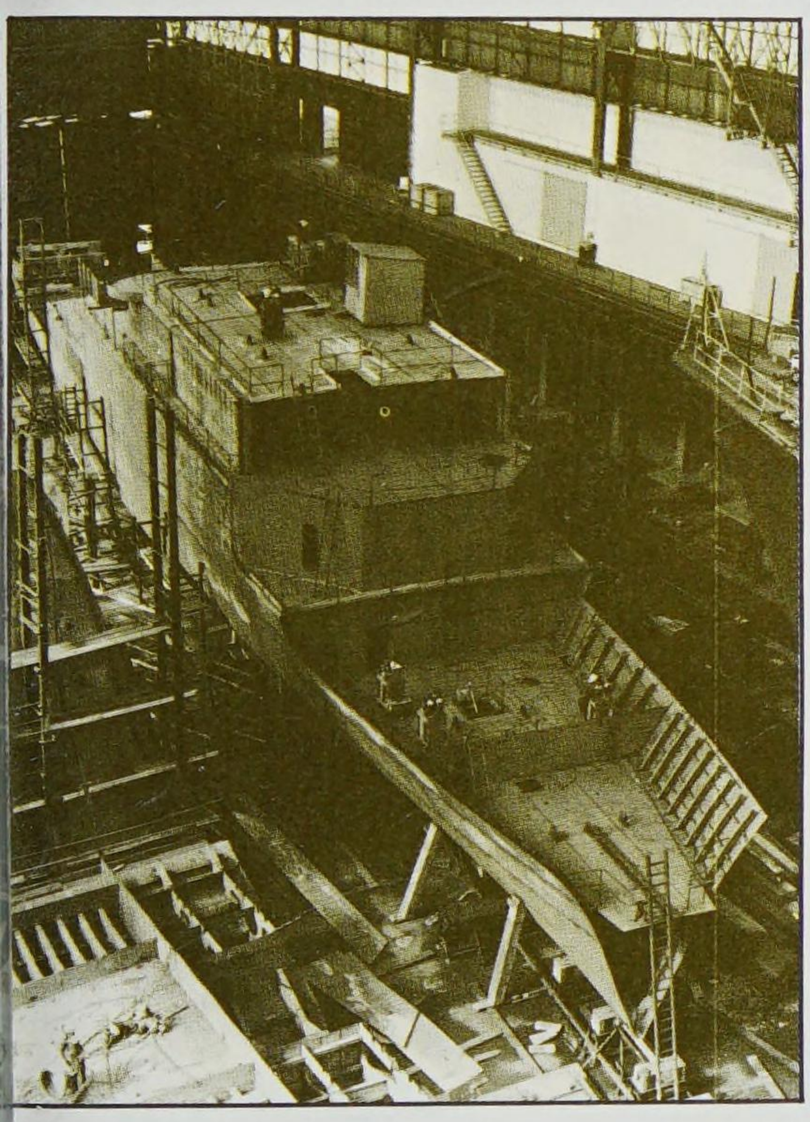
d'Estienne d'Orves

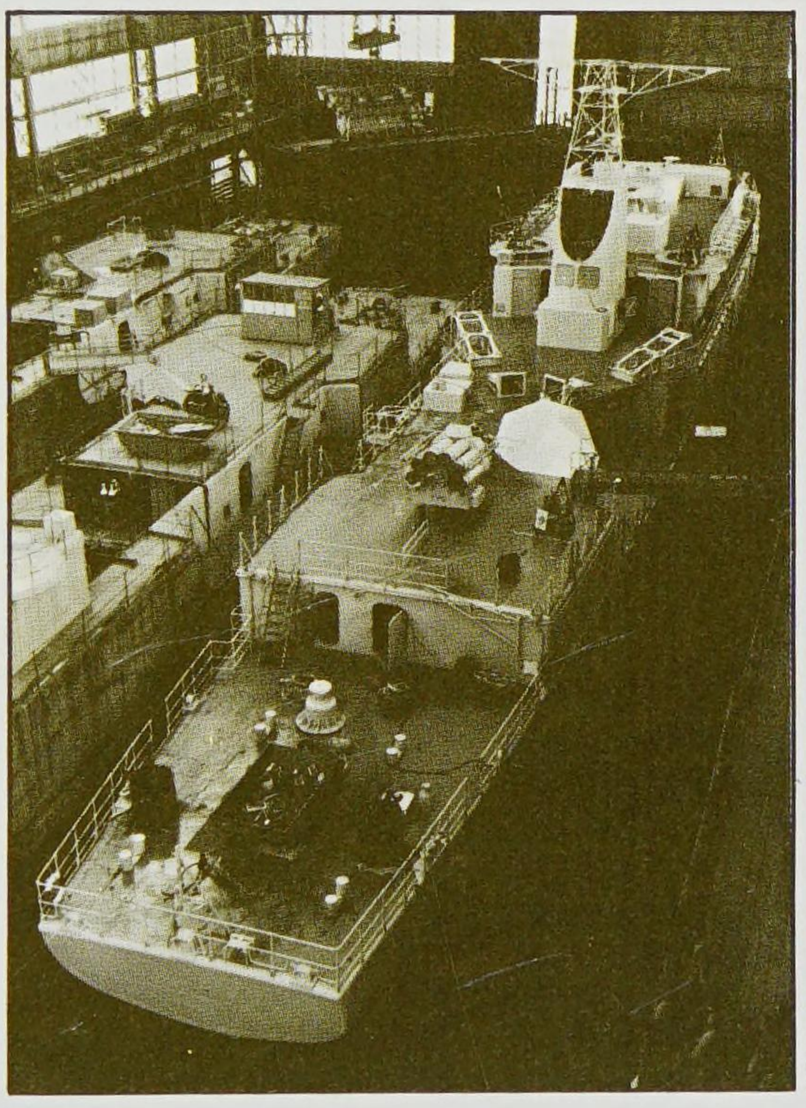
French escort class or *avisos*. Fourteen Type A69 *avisos* were authorized under the 1971 Programme, to replace the ageing E50 and E52 type *escorteurs rapides* built during 1952-60.

The class is intended for coastal antisub-

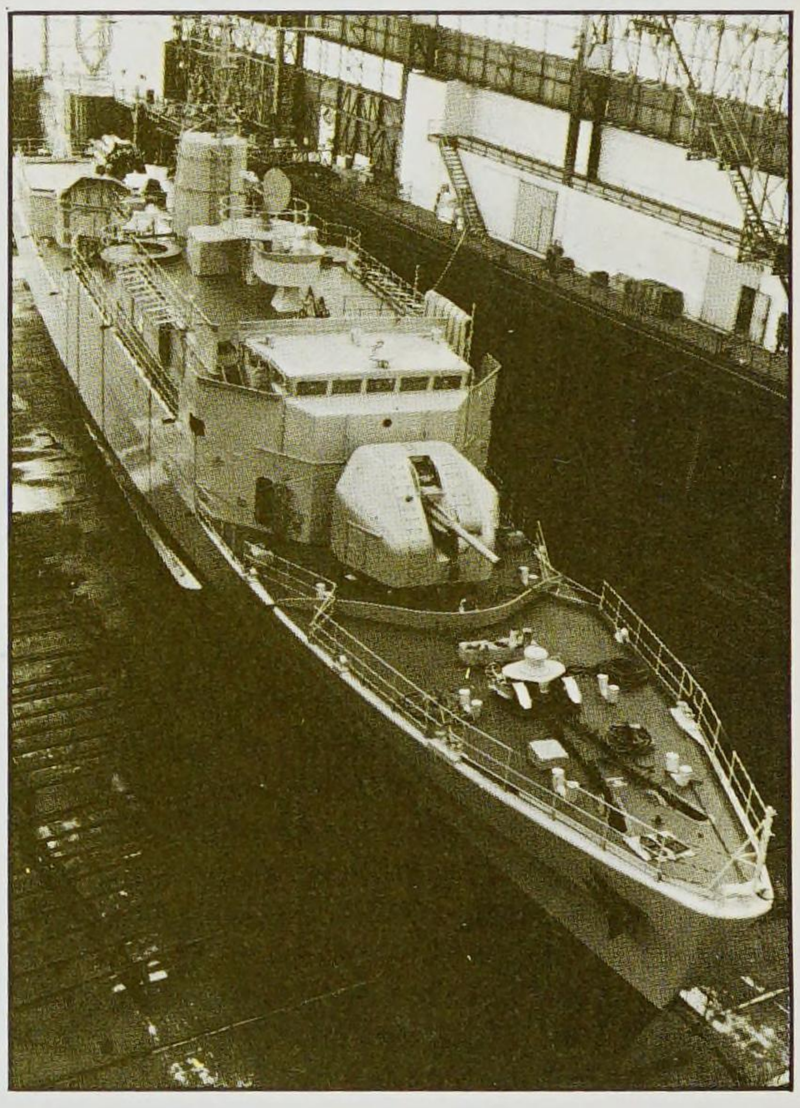


Stages in the construction of *d'Estienne d'Orves* Class antisubmarine escorts. The prefabricated sections are assembled in covered building berths (top), and the photographs below show the *d'Estienne d'Orves* on the 16th day of building (left), the *Jean Moulin* on the 284th day (centre) and the *Detroyat* on the 287th day (right). Average time from laying down to launch is around one year





PPL



PPL

marine escort, but the ships can operate overseas and for this purpose they can embark an extra detachment of an officer and 17 men. The units destined for the Mediterranean are armed with two MM38 Exocet surface-to-surface missile systems abaft the funnel, and the last two, *Commandant Blaison* and *Enseigne de Vaisseau Jacoubet* will be fitted with a hangar to operate the new lightweight Dauphin helicopter.

The ships are well-armed for their displacement, with a single 100-mm (3.9-in) dual-purpose gun forward, a six-barrelled 375-mm (14.76-in) antisubmarine rocket-launcher aft, and four fixed torpedo tubes for L3 homing torpedoes in the after superstructure. In addition two single 20-mm (0.79-in) Oerlikons are mounted at the after end of the superstructure. Two SEMT-Pielstick PC2V diesels drive two controllable-pitch propellers.

All fourteen ships were ordered from Lorient arsenal, and were to have been followed by the similar A70 type from the same yard. But in 1975 the French government announced that financial cuts had made it necessary to delay the commencement of the last of the class until April 1979, and to defer the A70 class indefinitely.

The class comprises *d'Estienne d'Orves* (No F.781); *Amyot d'Inville* (F.782); *Drogou* (F.783); *Detroyat* (F.784); *Jean Moulin* (F.785); *Quartier Maitre Anquetil* (F.786); *Commandant de Pimodan* (F.787); *Second Maitre le Bihan* (F.788); *Lieutenant de Vaisseau le Henaff* (F.789); *Lieutenant de Vaisseau Lavallée* (F.790); *Commandant l'Herminier* (F.791); *Premier Maitre l'Her* (F.792), projected; *Commandant Blaison* (F.793), projected; *Enseigne de Vaisseau Jacoubet* (F.794), projected.

The ships are prefabricated in a covered building berth, and work proceeds on two or more hulls at once, allowing double launches.

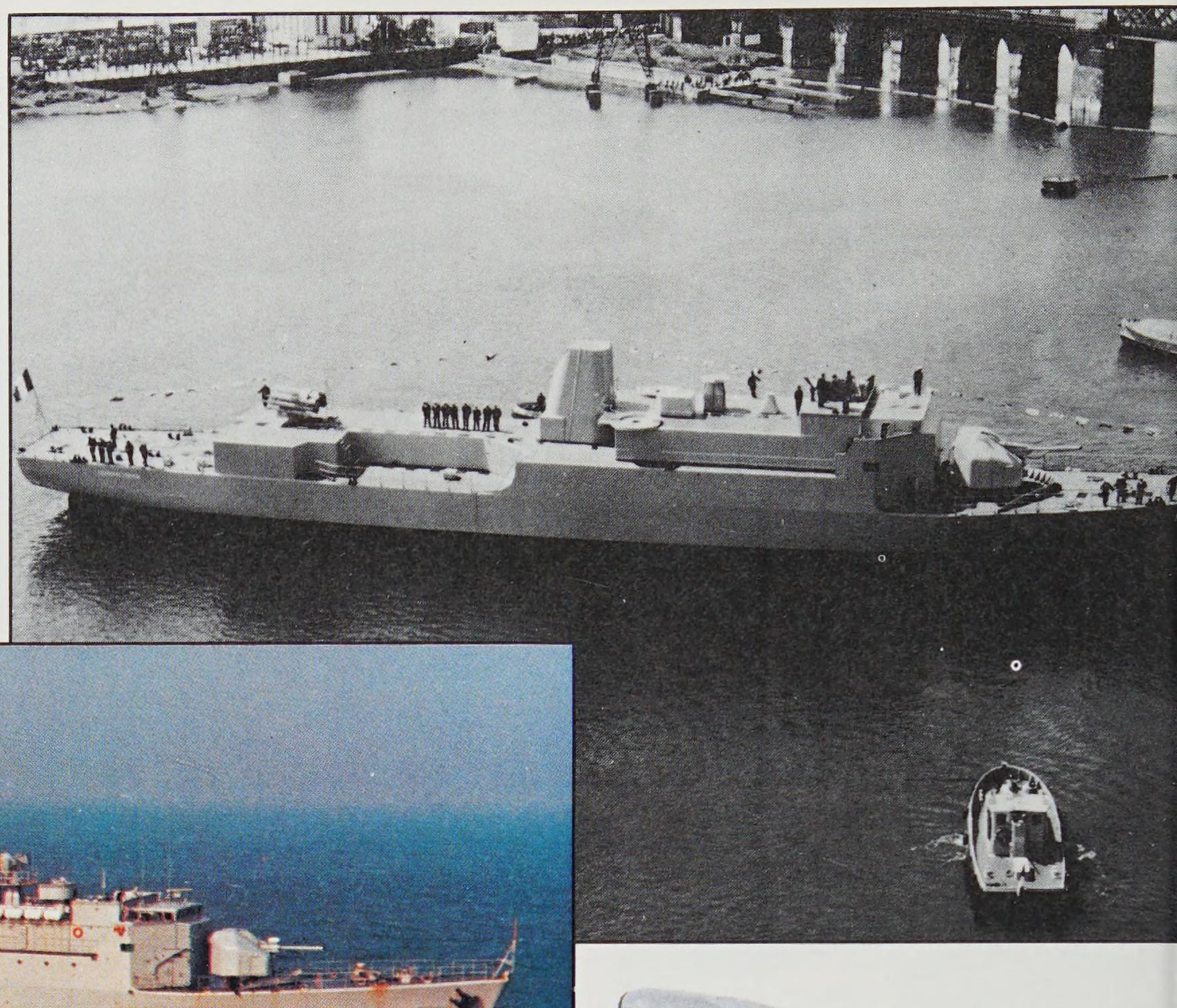
Two more ships, *Good Hope* and *Transvaal*, were ordered by South Africa about 1975, although to avoid international repercussions the date of the order was not announced. They are reported to be very similar to the French ships, but with a slightly different silhouette, and they would have had triple Mk 32 antisubmarine torpedoes but no Exocet missiles. However in November 1977 the French government suddenly announced the cancellation of the order, in deference to pressure from African countries. In all probability the ships will be taken back into the French navy's programme in place of two vessels not yet laid down. The *Good Hope* had been completed and was running trials at Lorient with a South African crew standing

by, and the *Transvaal* was to be completed in May 1978. The last two French ships will be equipped to operate a Dauphin helicopter.

See also *le Corse* Class, Dauphin.

Displacement: 950 tonnes (standard), 1170 tonnes (full load) *Length:* 80 m (262 ft 6 in) oa *Beam:* 10.3 m (33 ft 9 in) *Draught:* 3 m (9.8 ft) *Machinery:* 2-shaft diesels, 11 000 bhp=24 knots *Armament:* 2 Exocet MM38 SSMs (in four ships); 1 100-mm (3.9-in) 1968 DP gun; 2 20-mm (0.79-in) (2×1); 1 Mk 54 A/S rocket launcher; 4 torpedo tubes for A/S torpedoes *Crew:* 79

ECP Armées



Right: The _d'Estienne d'Orves_ after launching in 1973. _Below:_ In contrast to the clean lines of the newly-constructed vessel, an operational Type A69 with radar array, life rafts and the discolouration to the paintwork due to service

ECP Armées

d'Estrees

French 3rd Class cruiser. Sometimes rated as an *aviso* or sloop, *d'Estrees* was laid down at Rochefort arsenal in 1886, but not launched until October 1897, a typical example of French dilatory shipbuilding. In August 1914, she was part of the *Division d'Instruction de l'Ocean*, or seagoing training squadron, but transferred to the 2nd Light Squadron for service in the Channel. In 1915, she joined the 3rd Squadron off Syria, and patrolled off the Syrian and Libyan coasts.

In the summer of 1916 she went to Djibouti to protect the colony against an attack by Ethiopian forces, and remained in the Red Sea until 1918. After a refit at La Ciotat, she went to Saigon, and from June to August 1919 she was at Vladivostok, covering the French landing there. She was in the Far Eastern Naval Division until November 1, 1921, when she finally left Saigon to return to France via Bombay. She was stricken in October 1922 and sold in 1924.

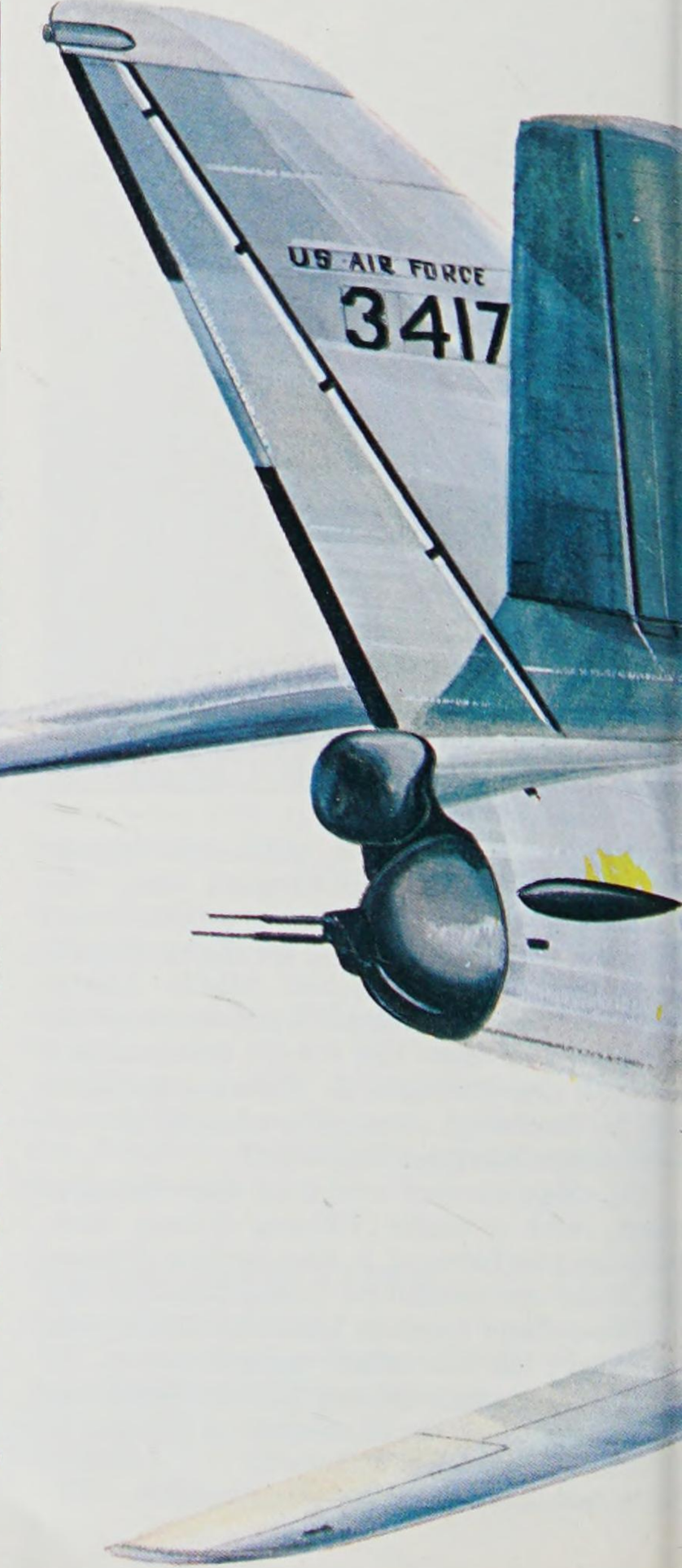
Displacement: 2440 tonnes *Length:* 95 m (311 ft) oa *Beam:* 12 m (39.3 ft) *Draught:* 5.4 m (17.7 ft) *Machinery:* 2-shaft triple-expansion, 8500 ihp= 21 knots *Protection:* 40-10 mm (1.57-in-0.4-in) deck *Armament:* 2 138.6-mm (5.5-in)/45-cal Model 1893 (2×1); 4 100-mm (3.9-in)/45-cal Model 1893 (4×1); 8 47-mm (1.8-in) (8×1) *Crew:* 250

Destroyer, Douglas BTD

US carrier-based torpedo/dive-bomber. One of the most difficult specifications in the history of combat aircraft was a 1941 US Navy requirement for a carrier-based dive-bomber. Douglas (El Segundo Division), under chief engineer Ed Heinemann, won over Curtiss-Wright with an extremely complex gull-winged aircraft, designated XSB2D-1, and named Destroyer. Features included a 2300-hp Wright R-3350-14 Duplex Cyclone, tricycle landing gear, thermal de-icing, internal bay for up to 1450 kg (3200 lb) of weapons, two wing cannon and a rear gunner controlling upper and lower remotely-aimed turrets. Two prototypes were built, followed by 30 single-seat BTD-1s with no rear turret.

Heinemann felt strongly that the BTD was too complex and over-weight, but he had to turn next to an even more complicated machine derived from the BTD, the formidable XTB2D-1 Devastator, powered by a 3350-hp Wasp Major with contra-prop and carrying four torpedoes. Two prototypes demonstrated superb handling, but the type was dropped in favour of the Skyraider.

Span: 13.71 m (45 ft) *Length:* 11.7 m (38 ft 7 in) *Gross weight:* 9072 kg (20 000 lb) *Maximum speed:* 558 km/h (347 mph)



Destroyer, Douglas B-66

US Air Force tactical bomber and reconnaissance aircraft. With renewed interest in the light attack bomber for ground support duties, as a result of its involvement in the Korean war, the USAF revived many existing types to obtain the rapid production required. Following the decision in 1951 to produce the English Electric Canberra as the Martin B-57, it was decided in February 1952 to utilize the US Navy's A3D Skywarrior.

Prototypes, as such, were not required, since the A3D had already proved itself extremely successful. However, much redesigning was necessary, and the first of an initial batch of five RB-66As flew on June 28, 1954, powered by two 4672-kg (10 300-lb) static thrust Allison J71-A-3 turbojets. Chief external differences were the extra wing area inboard of the engine pylons, but in fact there was hardly one point common to the A3D.

These five aircraft had been intended for night and all-weather photographic reconnaissance. In the event they were used mostly for service introduction and training. They were delivered in February 1956. The main production version was the three-seat RB-66B, also flown for the first time on June 28, 1954, and 145 of these were built.

Like the -66A it had a 36° swept wing, with the engine suspended from wing pylons. The main wheels of the tricycle undercarriage retracted into the fuselage, which also housed the attack and defence systems.

A light bomber version, the B-66B, which flew for the first time on January 4, 1955, served with Tactical Air Command. This variant, of which 72 were built, was capable of high or low level attack with a 6804-kg (15 000-lb) bombload; housed two 20-mm (0.79-in) cannon in a remote-controlled tail turret; and could deliver thermonuclear weapons. In spite of this, it was most widely used as a reconnaissance aircraft, and from 1957 onwards equipped tactical reconnaissance squadrons of the USAF.

A later batch of 36 aircraft, designated RB-66C, were a more specialized reconnaissance variant, fitted with sophisticated ECM (electronic countermeasures) equipment in wingtip pods and a 'chaff' dispenser in the tailcone, replacing the twin 20-mm (0.79-in) cannon of the B models. The RB-66C, first flown on October 29, 1955, carried a four-man electronics compartment in the bomb bay position.

The last Destroyer production model was the WB-66D, 36 of which were built for weather reconnaissance under combat conditions. They were equipped with a radar-controlled turret in the tail containing two 20-mm (0.79-in) cannon and were manned by five crew members. The 194th and last Destroyer was delivered in 1958. By the early 1970s the B-66 had been phased out of front-line duties and was used almost exclusively for ECM and reconnaissance missions in Vietnam and with the USAF in Europe; the tail turret having been removed and more modern equipment installed. As modified for ECM surveillance, the B-66B became EB-66B, the RB-66C was EB-66C and the RB-66B was redesignated EB-66E. By the late 1970s all were out of service.

(RB-66C) *Span:* 22.10 m (72 ft 6 in) *Length:* 22.91 m (75 ft 2 in) *Gross weight:* 37 648 kg (83 000 lb) *Maximum speed:* 998 km/h (620 mph)

Deutschland

German battleship class, built 1903-08. These were the last pre-Dreadnoughts built in Germany, and like many similar ships in other navies they were obsolete by the time they were completed, because of the incredibly rapid building of HMS *Dreadnought*. They were improved editions of the *Braunschweig*

The Douglas B-66 Destroyer was developed as a tactical bomber after experience in Korea, and was a land-based version of the US Navy's A3D Skywarrior. It served in this role until the late 1960s after which it was used for electronic counter measures (ECM) in both Vietnam and Germany. The first ECM version was the EB-66B with a four man compartment in the bomb bay and radomes at the nose, tail and wing tips. Subsequent marks were the EB-66C, and EB-66E which jammed enemy radar during attacks

Deutschland

Class, but to counter the introduction of heavier secondary guns in foreign ships the secondary battery was increased from 150-mm (5.9-in) to 170-mm (6.7-in) guns.

They resembled the *Braunschweig* Class, but could be distinguished by the half-cased funnels and the absence of secondary turret-guns amidships. During reconstruction after the First World War, four upper deck 170-mm (6.7-in) guns were replaced by four 150-mm (5.9-in) guns, and after 1936 a variety of light AA guns were added.

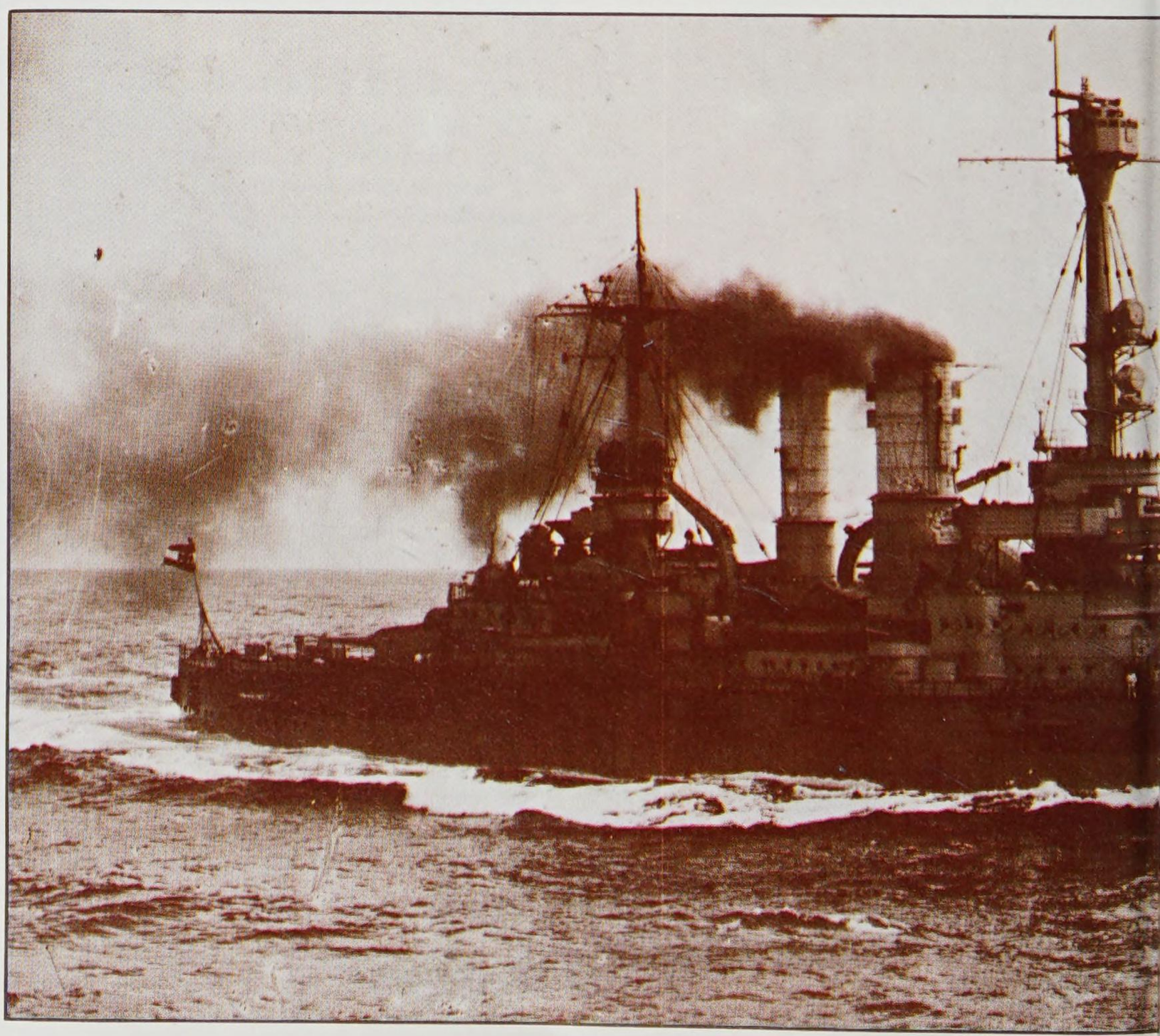
All five saw action at the Battle of the Skagerrak (Jutland) on May 31, 1916, in the 2nd Squadron of the German high seas fleet. They were too slow and weakly protected, but Admiral Mauve is said to have begged Admiral Scheer to allow his old ships to accompany the fleet to sea. It led to tragedy. During the night action a British destroyer's torpedo hit the *Pommern*; a ripple of flame spread along the waterline, and almost immediately the ship disintegrated in a colossal explosion, taking her entire crew with her. It is the only instance of a battleship blowing up from a single torpedo-hit, and the cause was undoubtedly the faulty stowage of the 170-mm (6.7-in) shells, with their nose-caps outwards in the wing magazines. This had been strongly criticized by the constructors, but Scheer had insisted that the ships could not be spared for the necessary refit.

After serving as the flagship of the 2nd Squadron, the *Deutschland* was reduced to an accommodation ship at Kiel in 1917, to release men for service in U-Boats. The *Schleswig-Holstein* took up similar duties at Bremerhaven, and then moved to Kiel in 1918. The *Schlesien* was relegated to training duties and spent most of the remainder of the war in the Baltic. The *Deutschland* was stricken under the Versailles Treaty in 1920, and was scrapped, but her four sisters were permitted to be retained by the Weimar Republic's *Reichsmarine* as coast-defence ships. For this role they were given a partial modernization, but they were earmarked for replacement by the 'pocket battleships' of the *Deutschland* type, and in 1935 the *Hannover* was stricken. She was intended for conversion to a radio-controlled target ship but this was never carried out, and she was finally scrapped at Bremerhaven at the end of the Second World War.

The surviving pair underwent major modernization to serve as gunnery training ships for Hitler's new *Kriegsmarine*. The two forward funnels were trunked together and the secondary armament was altered. Both ships saw active service in September 1939 when they bombarded Westerplatte near Danzig, but took little part in the rest of the war. The *Schlesien* was scuttled on May 4, 1945 after being mined off Swinemünde the previous day; she was salved in 1947 and was towed to Konigsberg (Kaliningrad) by the Russians, and then scrapped in 1949-56. Her sister *Schleswig-Holstein* was badly damaged by RAF bombers on December 18, 1945, while lying in Gotenhafen (Gdynia). The wreck burnt out and on March 21, 1945, she was scuttled to block the harbour. The wreck was not finally broken up until 1956.

Displacement: 13 191 tons (normal), 14 218 tons (full load) *Length:* 127.71 m (419 ft) oa *Beam:* 22.17 m (72 ft 9 in) *Draught:* 7.7 m (25 ft 3 in)

Name	launched	builder
Deutschland	11/1904	Krupp, Germania
Hannover	9/1905	Wilhelmshaven dockyard
Pommern	12/1905	AG Vulcan, Stettin
Schleswig-Holstein	12/1906	Krupp, Germania
Schlesien	5/1906	Schichau, Danzig



The *Deutschland* Class battleships *Schleswig-Holstein* (above) and *Schlesien* (below). Both ships, improved versions of the *Braunschweig* Class, took part in the bombardment of the Polish fort at Westerplatte near Danzig, but saw little further action in the Second World War.

normal *Machinery:* 3-shaft reciprocating, 17 000 ihp=18 knots *Protection:* 240-102 mm (9½-4 in) belt; 70-44 mm (2¾-1¾ in) decks; 285-170 mm (11¼-6¾ in) turrets; 305-140 mm (12-5½ in) conning tower *Armament:* (As built) 2 280-mm (11-in)/40-cal (2×2); 14 170-mm (6.7-in)/40-cal (14×1); 20 88-mm (3.5-in)/35-cal (20×1); 6 45-mm (17.7-in) torpedo tubes (1 bow, 1 stern, 4 beam, all submerged); (*Schlesien* and *Schleswig-Holstein* from 1936) 4 280-mm (11-in) (2×2); 10 150-mm (5.9-in)/45-cal (10×1), removed 1944; 4 88-mm (3.5-in)/45-cal AA (4×1), removed 1944; 4 37-mm (1.4-in) AA (2×2); 4 20-mm (0.79-in) AA (4×1); 10 40-mm (1.57-in) Bofors AA (10×1), added 1944; 22 20-mm (0.79-in) AA (4×4, 3×2), added 1944; 4 19.7-in (50-cm) torpedo tubes (in trainable mountings on battery deck) *Crew:* 743 (214 cadets embarked in *Schlesien* and 175 in *Schleswig-Holstein*)

Deutschland

German pocket battleship class, built 1929-36. In 1926 Germany began to consider a design of ships to replace the old pre-Dreadnought battleships she had been allowed to retain under the terms of the Versailles Treaty as part of her coast defence force. The Treaty specified that any such replacement capital ship should not exceed 10 000 tons or be armed with guns heavier than 280-mm (11-in) calibre. This clause was designed to provide for no more than a small armoured coast defence vessel but it did not allow for German ingenuity. Partly by ignoring the Treaty (the ships actually displaced about 12 000 tons), and partly by adopting weight-saving methods, they produced what can best be described as a small battlecruiser for deep sea commerce raiding. Three ships of this design were built, the *Deutschland, Admiral Scheer* and *Admiral Graf Spee*, constructed between 1929 and 1936. They were the only examples of their type and were classified officially as *Panzerschiffe* (armoured ships) but were soon to become more popularly known as pocket battleships.

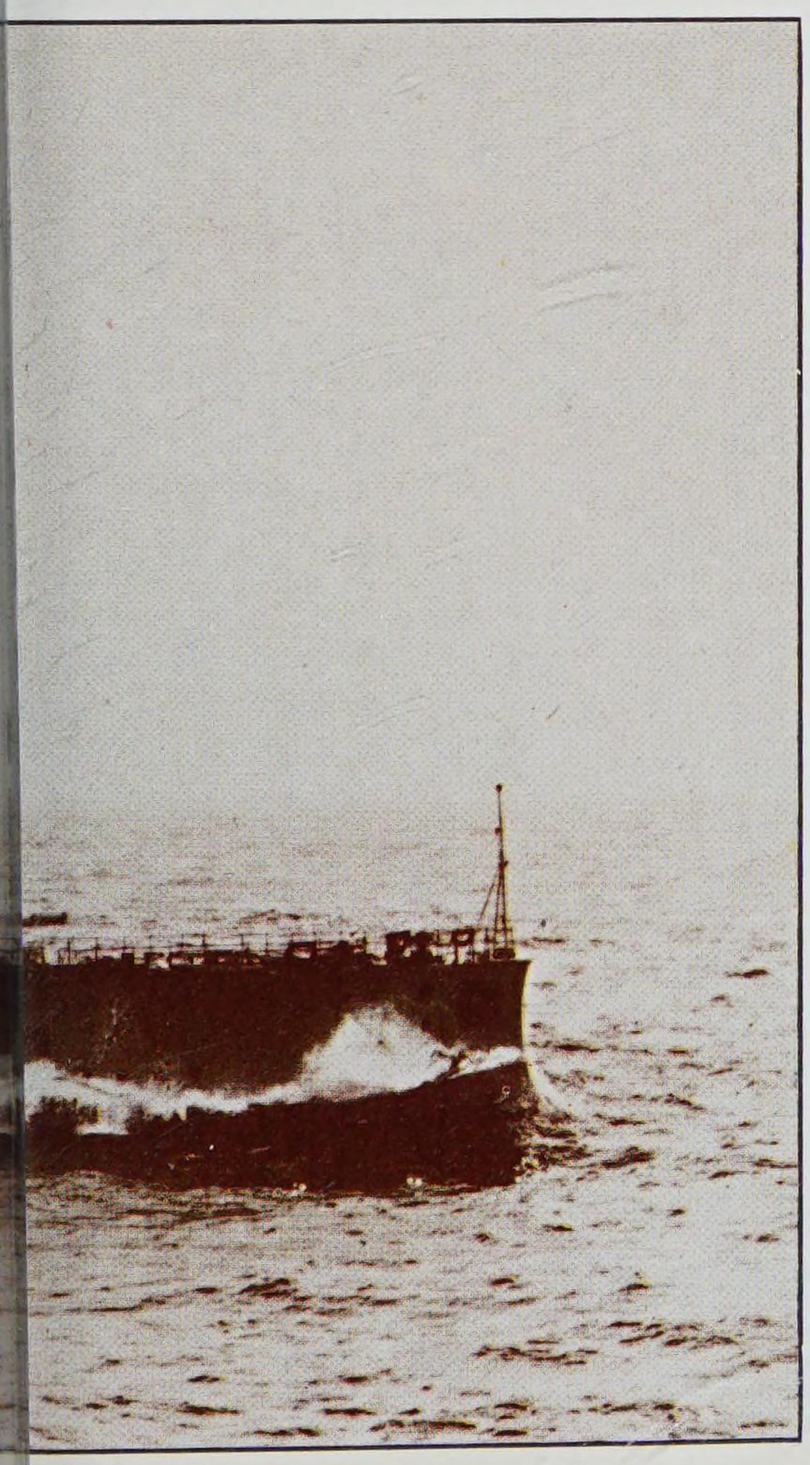


Foto Drüppel

In 1929, when Germany announced her intention to build the *Deutschland*, the need for naval rearmament was officially explained as necessary for protecting the sea lanes in the Baltic against any future interference by Russia. It was also announced that the new ship was to have an endurance of 16 100 km (10 000 miles) at 20 knots and it must have been obvious to most foreign naval authorities that this was rather excessive for the restricted waters of the Baltic!

In essence the design was for a ship with an armament heavy enough to defeat any faster ships and sufficient speed to escape from more powerful ships. The only exceptions to this rule at the time were the three British battlecruisers *Hood, Renown* and *Repulse*, with speeds in excess of 30 knots, but as Britain was not seen as a potential enemy this was not considered a problem.

The main armament consisted of two triple 280-mm (11-in) gun turrets mounted fore and aft which gave the ships their major advantage over an enemy cruiser. Their armour however was comparatively weak, being penetrable by both 203-mm (8-in) and 152-mm (6-in) shells at battle ranges, and as they were substantially slower than modern cruisers they could not choose to outrange any such adversary with their heavier guns or otherwise dictate the tactics of battle.

One of the most novel features of the design was the use of diesel engines for the propulsion system, which gave the advantages of reduced weight, space and manpower and speed of starting and acceleration compared with a conventional steam plant. The arrangement consisted of two sets of four 9-cylinder MAN diesel engines each driving a shaft via a Vulcan reduction gearbox. The designed speed of 26 knots was exceeded on trials but in the long term the installation was not as successful as anticipated. Other weight saving devices included the adoption of high-tensile steel and electric welding in the hull structure and the use of alluminium and other light materials for unstrengthened parts of the structure and fittings.

Each of the three ships differed in detail. The *Admiral Scheer* had her side armour increased in height, had a heavier bridge structure than *Deutschland* and had her beam increased to compensate for the additional topweight. The *Admiral Graf Spee* was a repeat of *Scheer* except that her side armour was reduced to the same height as that in *Deutschland* and increased to 80 mm (3.15 in) thickness while her deck protection was extended to the full width of the ship instead of terminating at the top of the 40 mm (1.57 in) torpedo bulkheads as in the earlier pair.

The *Deutschland* was renamed *Lützow* in 1940, as it was considered bad for national morale for a ship named after the fatherland to be sunk. In 1938 the *Graf Spee* became the first German ship to be fitted with radar, but she was lost in 1939. The surviving pair were reclassified as heavy cruisers in 1940 and *Scheer* was fitted with a new bridge of similar design to that in *Deutschland*. By 1945 the *Scheer* had 42 20-mm (0.79-in) AA guns added to her armament while *Lützow* carried an extra two 37-mm (1.46-in) and 28 20-mm (0.79-in) AA.

The *Deutschland* was the seagoing training ship for the Kriegsmarine before the war, and while on the non-Intervention Patrol during the Spanish Civil War was bombed by Loyalist aircraft. On August 24, 1939 she slipped out into the Atlantic, but her career as a commerce-raider was a disappointment, and she sank only two ships. She was overhauled from November 1939 to April 1940 and saw action in Norway under her new name (changed in February). The only major action in her career was the inglorious battle of the Barents Sea on December 31, 1942, when she and the *Admiral Hipper* were driven off from a convoy by its escorting destroyers. She was saved from Hitler's order to 'scrap the lot' after this fiasco, and was relegated to training in the Baltic. On April 16, 1945 she was bombed at Swinemünde and on May 4 she was scuttled there to avoid capture by the Allies.

See also *Admiral Graf Spee, Admiral Scheer*

Displacement: 11 700 tons (standard), 15 900 tons (full load); (*Graf Spee* and *Scheer* 12 100-16 200 tons) *Length:* 185.7 m (609 ft 3 in) *Beam:* 21.18 m (69 ft 6 in), *Deutschland* 20.57 m (67 ft 6 in) *Draught:* 6.64 m (21 ft 7 in) *Machinery:* 2-shaft geared diesel engines, 56 000 bhp=26 knots *Protection:* 60 mm (2.4 in) sides; 140-50 mm (5½-2 in) turrets; 75-40 mm (3-1½ in) decks *Armament:* 6 280-mm (11-in) (2×3); 8 150-mm (5.9-in) (8×1); 6 105-mm (4.1-in) (3×2); 8 37-mm (1.46-in) AA (4×2); 8 53-cm (21-in) torpedo tubes (2×4) *Aircraft:* 2 *Crew:* 1120

Deutschland

German training ship, built 1959-63. *Deutschland* was the first ship of the new Federal German Navy to exceed the limit of 3000 tons placed on the West Germans under the Washington Treaty, and she is an enlarged frigate equipped with a variety of weapons and machinery for training purposes. She was ordered in 1956 and was originally to be named *Berlin.* She was launched at the Nobiskrug shipyard at Rendsburg on November 5, 1960 and started sea trials in January 1963, her NATO pendant number being A.59.

The armament comprises four French 100-mm (3.9-in) dual-purpose guns, six Breda 40-mm (1.57-in) Bofors guns (two twins and two singles), two quadruple 375-mm (4.8-in) Bofors antisubmarine rocket launchers behind B gun, and six torpedo launchers. The machinery plant is a combination of Daimler-Benz and Maybach diesels, and MAN geared steam turbines. A full outfit of Dutch radar and fire control, plus hull-mounted sonar is carried.

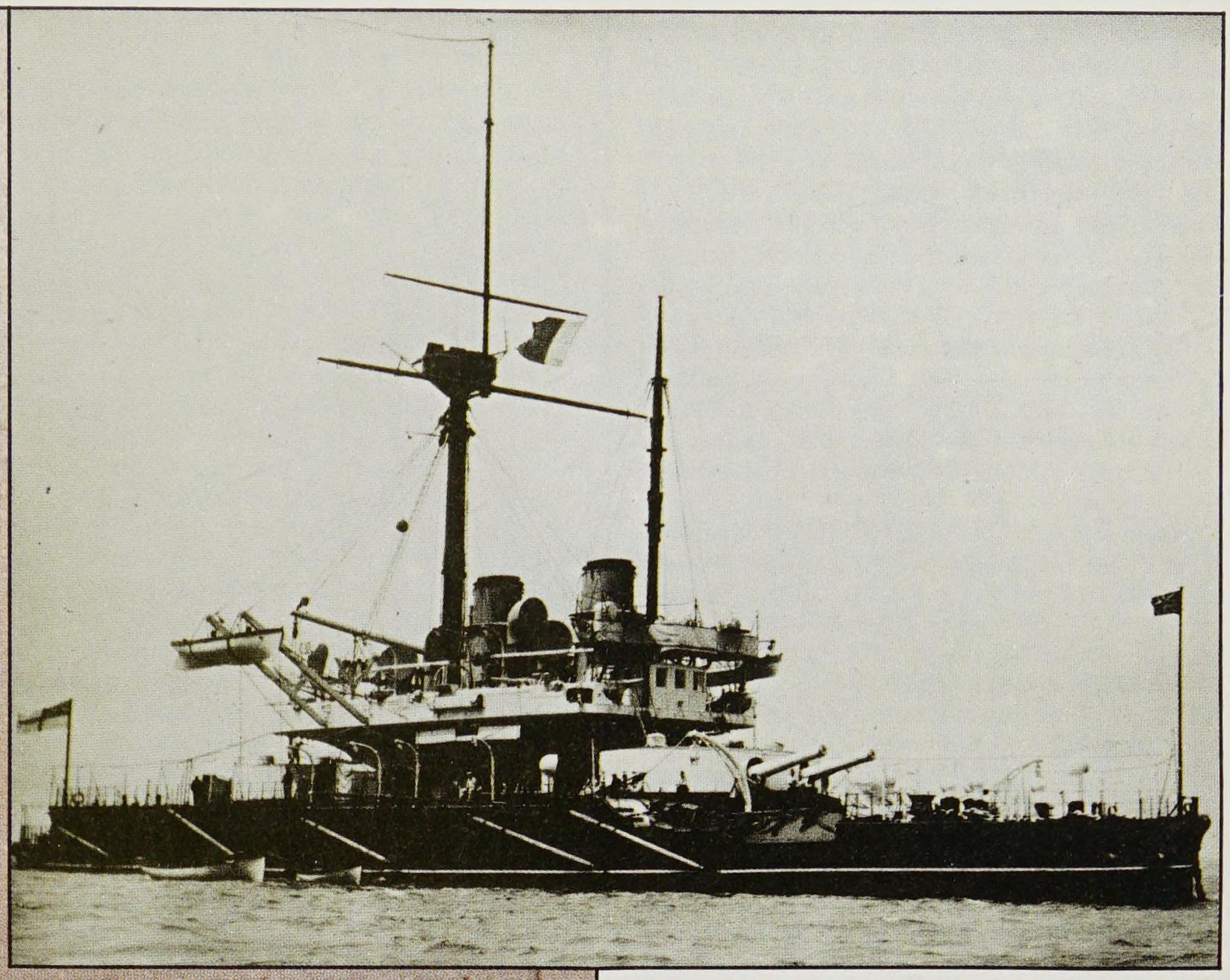
The ship embarks 250 cadets for a series of four-month voyages to various parts of the world. In 1978 she was due to be rearmed with more up-to-date hardware to train personnel in handling the newer weapons used by West Germany.

Displacement: 4880 tons (normal), 5400 tons (full load) *Length:* 145 m (475 ft 8¾ in) oa *Beam:* 18 m (59 ft) *Draught:* 4.8 m (15 ft 8 in) *Machinery:* 3-shaft diesel, 6800 bhp+geared steam tur-

Deutschland

The West German training cruiser *Deutschland*, the first postwar warship to exceed 3000 tons. She has a varied armament designed for instructional purposes and her machinery, two Daimler-Benz and two Maybach diesels, is also deliberately different for training purposes. Her full complement of 554 comprises 33 officers, 271 men and 250 cadets. A wide variety of radar equipment is carried for sea-going instruction, three navigation and surface warning sets, SGR 103, 105 and 114, one LW-02/3 air warning set, one DA 02 target designation set and two M45 fire control sets, an M2/2 and an M4. All the radar equipment is built by Hollandse Signaalapparaten. The *Deutschland* was ordered in 1956 when her name was to have been *Berlin*

Die Bildstelle der Marine



IWM

Above: **HMS *Thunderer*, a *Devastation* Class battleship launched in 1872 but not commissioned until 1877**

bines, 8000 shp= 22 knots (max) *Armament:* 4 100-mm (3.9-in) (4× 1); 6 40-mm (1.57-in) (2× 2, 2× 1); 2 375-mm (14.8-in) A/S rocket-launchers; 6 53-cm (21-in) torpedo-launchers (can also lay mines) *Crew:* 304, plus 250 cadets

Devastation

British battleship class. The *Devastation* was designed in 1868, within a decade of the introduction of the ironclad, and embodied all the basic elements for the subsequent development of the modern battleship. She was in many ways the most revolutionary warship of any time, being the first ocean going turret ship to be constructed without masts or yards and dependent entirely on her steam machinery.

She was a very successful ship but at the time of her completion was severely criticized, largely because of distrust of the reliability of the steam engine and turret ships in general and prejudice against her somewhat ugly appearance. Later in her career, when the sailing warship no longer dominated the scene, she and her sister, *Thunderer*, received the acclaim they deserved.

The *Devastation*, the first iron ship to be built by Portsmouth dockyard, was laid down in 1869, launched in 1871 and completed in 1873. The *Thunderer* was laid down at Pembroke dockyard in 1869 and launched in 1872, but her completion was delayed pending the results of her sister's trials and she did not commission until 1877.

Their basic design was very simple. On a raft hull with only 1.3 m (4 ft 6 in) freeboard, a central armoured breastwork was constructed, at each end of which was a turret containing two 35-ton rifled muzzle loaders. Between the two turrets was a narrow superstructure carrying two funnels, a small bridge

and the ship's boats on a single mast. The sides of the breastwork and turrets were protected by wrought iron armour and the hull carried a full-length belt which, at the time of *Devastation*'s completion, was inpenetrable by any existing gun except at point-blank range. The superstructure and upper section of the forecastle and side-plating were unprotected, except for the provision of an armoured conning tower between the funnels. The guns had almost completely free arcs of training, being blocked only by each other, a feature impossible to achieve in a masted ship.

Soon after completion, the *Thunderer*'s forward turret was reequipped with 317.5-mm (12.5-in) rifled muzzle-loaders and both ships were fitted with a few machine-guns on the superstructure. During 1891-92, both ships were rearmed, new 254-mm (10-in) breech-loaders replacing the early weapons in the turrets, and 6 6-pdrs (6×1) and 8 3-pdrs (8×1) supplanting the machine-guns in the superstructure. They were also reengined with a modern triple-expansion steam plant giving 7000 ihp for a speed of 14 knots. New funnels and masts were fitted and a new bridge fitted above the original bridge and chart house.

Both vessels served in the Home and Mediterranean Fleets and after rearming were employed mainly as harbour defence vessels in various locations. However, when the *Devastation* was portguard ship at Gibraltar (1898-1902) she is said to have spent more time at sea with the Fleet than in harbour. The *Thunderer* was placed in reserve in 1900 and the *Devastation* in 1902, both vessels being removed from the effective list in 1907. The *Devastation* was sold for scrap in 1908 and her sister in the following year.

Displacement: 9330 tons (normal) *Length:* 86.9 m (285 ft) *Beam:* 19 m (62 ft 4 in) *Draught:* 7.9 m (26 ft) *Machinery:* 2-shaft steam piston engines, 6500 ihp = 13.5 knots *Protection:* 305 mm (12 in) sides, 356 mm (14 in) turrets, 76 mm (3 in) deck *Armament:* 4 35-ton muzzle loaders (2×2) *Crew:* 358

Devastator, Douglas TBD

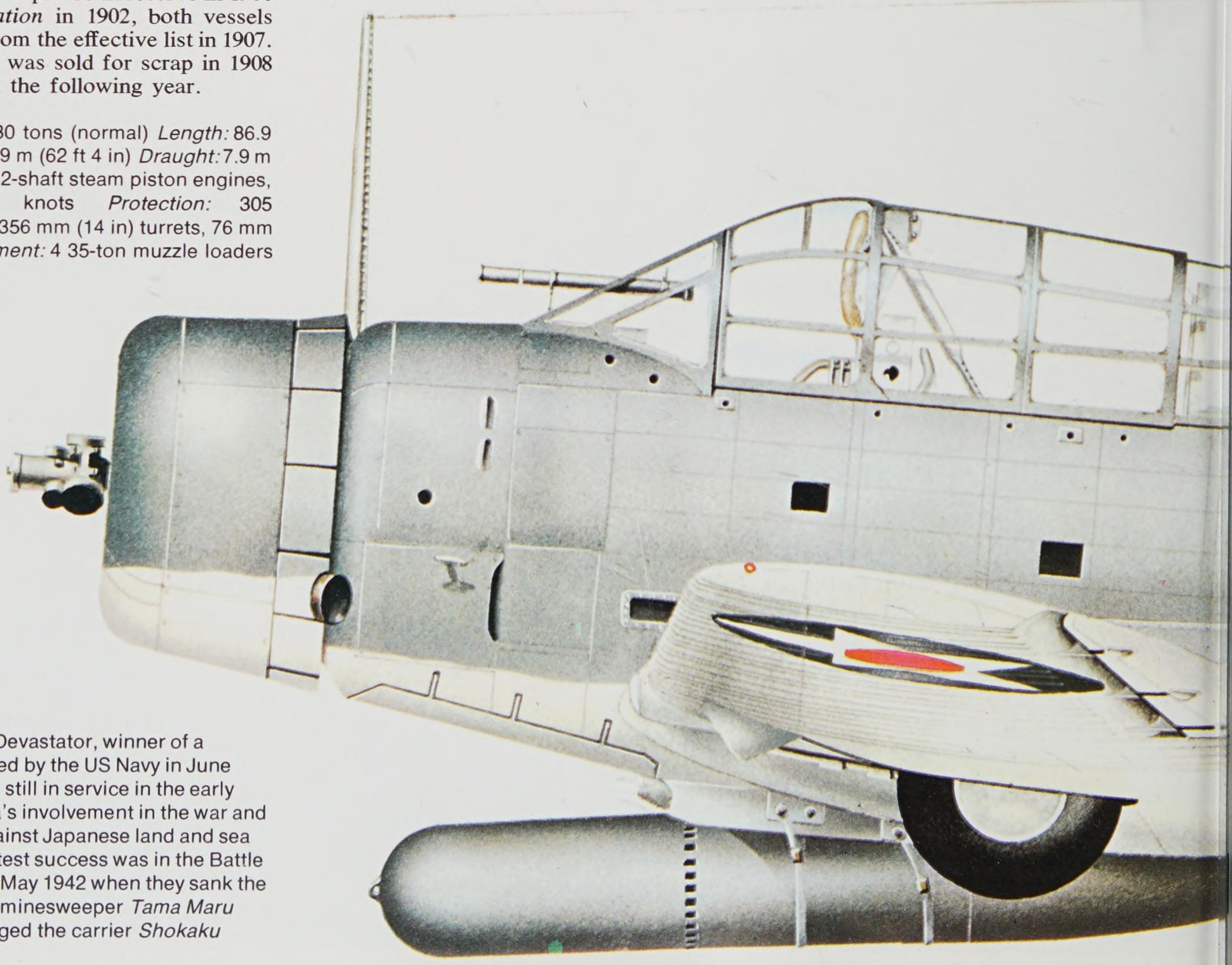
US carrier-based torpedo-bomber. The Devastator was the winner of a competition initiated by the US Navy on June 30, 1934, for a torpedo-bomber capable of operation from a new series of carriers then being developed.

The XTBD-1 prototype, powered by an 800-hp Pratt & Whitney XR-1830 engine, flew for the first time on April 15, 1935. It was an all-metal, low-wing monoplane, with a long canopy over the tandem seats for the three-man crew (pilot, torpedo officer/bomb aimer and rear gunner/radio operator). The backward-retracting main undercarriage wheels, when in the 'up' position, protruded below the wings, to give some protection in the event of a crash-landing on the deck.

A new feature was the hydraulic mechanism used to fold the wings upwards for stowing. After successful prototype trials, the XTBD-1 was ordered into production in February 1936 and deliveries to the US Navy, as the TBD-1 Devastator, began on June 25, 1937. There were 129 built, each powered by a 900-hp R-1830-64 Twin Wasp radial engine with a redesigned cowling and having a raised canopy over the pilot's cockpit.

The TBD-1 was somewhat inadequately armed, with only one fixed 7.62-mm (0.30-in) machine-gun above the engine and one 12.7-mm (0.50-in) gun on a movable mounting in the rear cockpit. An internal bay could carry one 53-cm (21-in) torpedo or one 454-kg (1000-lb) armour-piercing bomb. The range with a torpedo aboard was 700 km (435 miles), and the torpedo/bomb aimer lay prone beneath the pilot's seat, sighting through two windows in the fuselage floor. One aircraft was converted to TBD-1A twin-float configuration, but after tests during 1939-43 production was not considered viable. However, flotation bags were carried in the wings of all Devastators for use if the aircraft ditched in the sea. The first TBD unit was VT-3 (USS *Saratoga*), formed in November 1937; followed by VT-5 (*Yorktown*), VT-6 (*Enterprise*), VT-8 (shore-based), VS-71 (*Wasp*) and VS-42 (*Ranger*); others went to various units of the Navy and Marine Corps.

A hundred or so TBDs were still in service when Japan attacked Pearl Harbor in December 1941, of which 69 were in Fleet operation. They fought against the Japanese in the Marshall and Gilbert and Ellice Islands as early as February 1942. Against slight opposition at this stage of the war, they acquitted themselves well, inflicting considerable damage, claiming a Japanese cruiser sunk, as well as other shipping destroyed. Devastators from VT-5 and VT-6 took part in the attacks on the Japanese-held islands of Kwajalein and Jaluit on February 1, 1942, the first US offensive action in the Pacific against Japan. Squadron VT-6 bombed Wake Island on February 24, 1942, each of its TBDs carrying six 45-kg (100-lb) bombs under each wing. The greatest success achieved by



The Douglas TBD Devastator, winner of a competition initiated by the US Navy in June 1934. The type was still in service in the early months of America's involvement in the war and performed well against Japanese land and sea targets. Their greatest success was in the Battle of the Coral Sea in May 1942 when they sank the carrier *Shohu* and minesweeper *Tama Maru* and severely damaged the carrier *Shokaku*

Devastators was in the battle of the Coral Sea, May 4-8, 1942. They sank the carrier *Shohu* and the minesweeper *Tama Maru,* and seriously damaged the carrier *Shokaku.*

However, a month later at Midway (June 4-6, 1942), TBDs saw their last front-line action. Of 41 involved in the combat, 37 were annihilated, trapped between flak from the ships and the waiting Zeros. Although their operational action was not over, later and more modern types—such as the Avenger—eventually fulfilled the inherent promise in the overall design of the TBD-1. Had its defensive firepower been heavier, its useful combat life might have been longer.

(TBD-1) *Span:* 15.24 m (50 ft) *Span, wings folded:* 7.82 m (25 ft 8 in) *Length:* 10.67 m (35 ft) *Gross weight:* 4624 kg (10 194 lb) *Maximum speed:* 331 km/h (206 mph)

Devonshire

British cruiser class. Constructed under the 1901-02 Estimates, the six ships of the *Devonshire* Class were laid down in 1902 and completed in 1905. They were the last British armoured cruisers designed primarily for trade protection, with the French fleet considered as the most likely enemy. They were

Left: A TBD Devastator prepares to land on the carrier *Saratoga.* A vulnerable aircraft, it was not popular with its three-man crews

Devonshire

also the last vessels to be designed under the direction of Sir William White, the Admiralty's chief designer since 1885.

Originally they were to have been repeats of the earlier County Group, the *Kent* Class, but the design was modified to incorporate four single 7.5-in (190-mm) gun turrets. These guns were disposed on the forecastle and quarterdeck, where they replaced the unsuccessful twin 6-in (152-mm) turrets of the *Kent*, and abreast the foremast where they replaced the two foremost 6-in (152-mm) gun casemates on each side. The remaining 6-in (152-mm) gun casemates were reduced to six by omitting the midships position on each side of the upper deck. These modifications, together with an increase in the side armour from 102 mm (4 in) to 152 mm (6 in), resulted in a 1000 tons increase in displacement and a one-knot loss in speed. However, with an armament of greater efficiency and improved protection they represented a substantial improvement on the earlier class.

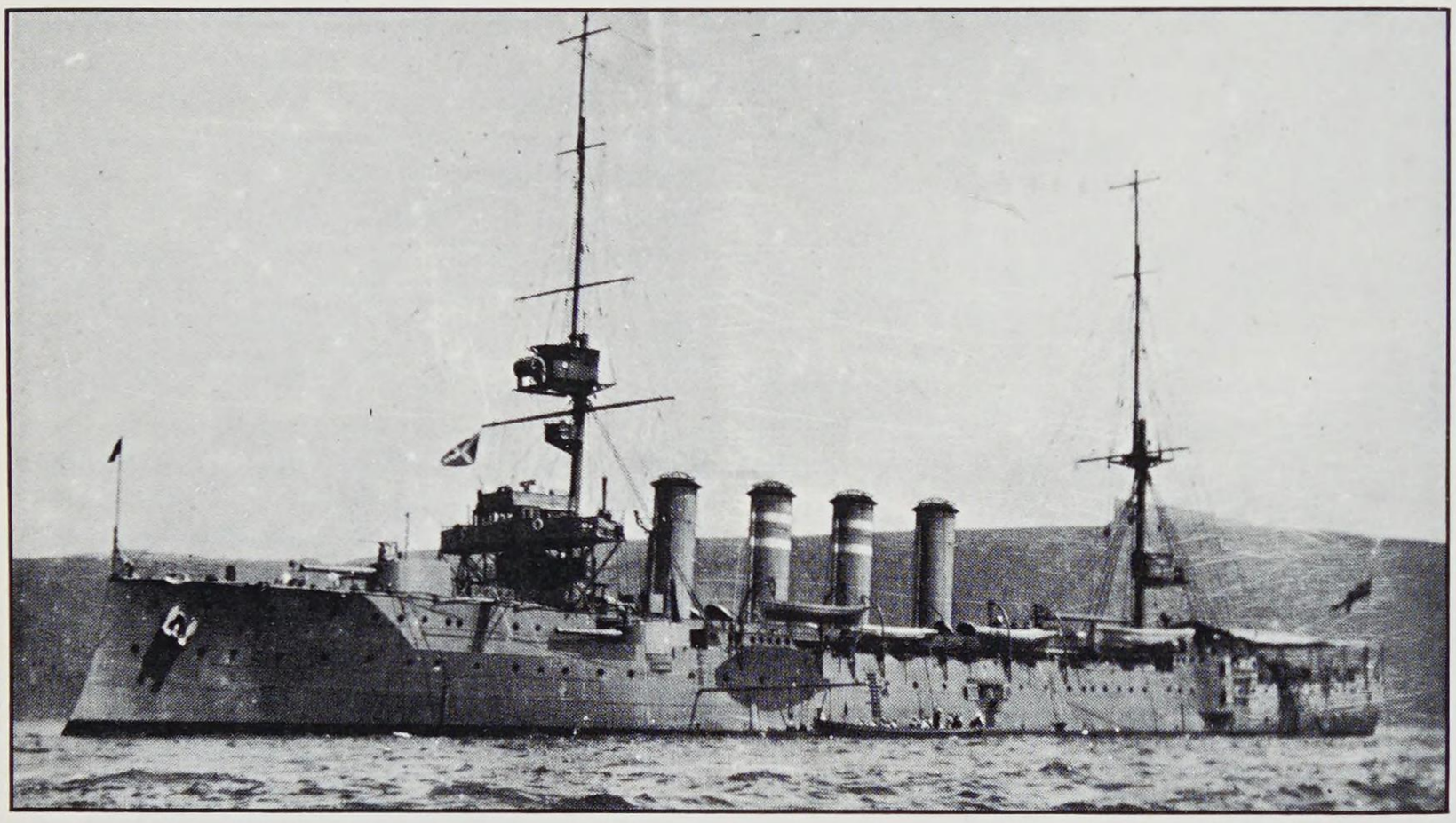
Most of their early service was in home waters, the only exceptions being *Carnarvon* (Mediterranean 1905-07) and *Hampshire* (Mediterranean 1911-12, China Station 1912-14). From 1914 the *Antrim, Argyll, Devonshire* and *Roxburgh* served with the 3rd Cruiser Squadron of the Grand Fleet. The *Argyll* was wrecked on Bell Rock, near Dundee, on October 28, 1915, but the other three transferred to the North America and West Indies stations in 1916. They remained with this force until the end of the war, being employed mainly on Atlantic escort and patrol work. The *Roxburgh* rammed and sank the submarine *U 89* off Northern Ireland on February 12, 1918, while on escort duty.

The *Carnarvon* operated off South America during 1914-16 and took part in the battle of the Falkland Islands in 1914. She was severely damaged on February 22, 1916, when she ran onto a shoal near the Albrolhos rocks, and after repairs she joined her sisters on the North American Station. The *Hampshire* was part of the 6th Cruiser Squadron of the Grand Fleet from 1914 and took part in the Battle of Jutland. A few days after this action she embarked Lord Kitchener and his staff who were taking passage to Russia. On June 5, 1916, when she was off the Shetland Islands, the ship struck a mine laid a few days earlier by the submarine *U 75*. The weather at the time was very rough and the ship foundered taking all but 12 of those on board with her, including Kitchener and the ship's captain.

The ships were not modified to any great extent, but during the war all had their four main deck 6-in (152-mm) casemates plated-in and four single 6-in (152-mm) guns mounted on the upper deck, where they had a better command. The four surviving vessels were sold for scrap during 1921-22.

Antrim—built by J Brown
Argyll—built by Scotts
Carnarvon—built by Beardmore
Devonshire—built by Chatham dockyard
Hampshire—built by Armstrongs
Roxburgh—built by London and Glasgow

Displacement: 10850 tons (Navy List) *Length:* 144.3 m (473 ft 6 in) *Beam:* 20.9 m (68 ft 6 in) *Draught:* 7.3 m (24 ft) *Machinery:* 2-shaft, triple-expansion steam engines, 21000 ihp=22 knots *Protection:* 152 mm (6 in) sides, 152 mm (6 in) guns, 51 mm (2 in) deck *Armament:* 4 7.5-in (190.5-mm) (4×1); 6 6-in (152-mm) (6×1); 2 12-pdr (2×1); 17 3-pdr (17×1); 2 18-in (46-cm) torpedo tubes (submerged) *Crew:* 655



Tom Molland

Above: **HMS *Roxburgh*, a *Devonshire* Class cruiser which sank *U 89* off Northern Ireland on February 12, 1918. *Below:* HMS *Hampshire*, the vessel which sank with Lord Kitchener aboard**

Tom Molland

HMS *Kent*, a *Devonshire* Class destroyer, passes through the English Channel. Her crew are drawn up on deck with a guard by B turret

Devonshire

British destroyer class, built 1959-70. Two 'fleet escorts' or large destroyers were projected under the 1955-56 Naval Estimates, followed by another two the following year. Originally intended to be a 'super-*Daring*', the design underwent no fewer than 64 changes. The original concept was a 4000-ton destroyer capable of 38 knots and armed with three single 5-in (127-mm) guns, each firing 80 rds/min, whose role was to destroy *Sverdlov* Class cruisers with gunfire and homing torpedoes. However, the new First Sea Lord, Admiral of the Fleet Earl Mountbatten, rejected the design as it had no guided-missile defence against air attack. Finally, after many vicissitudes, only the machinery was left of the original design, and it had been recast to include a Seaslug missile system and two Limbo antisubmarine mortars aft.

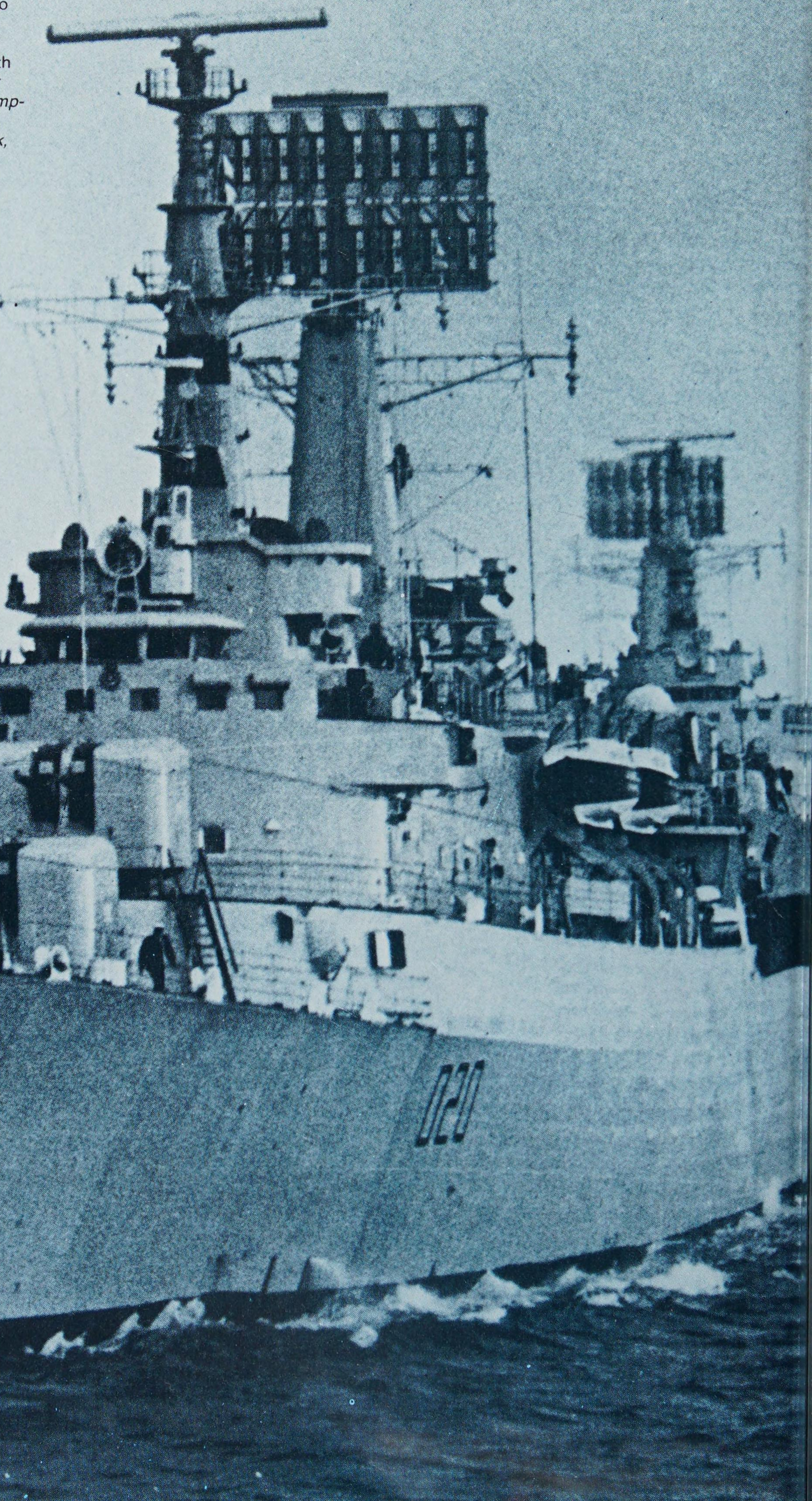
What finally emerged in 1962 was a handsome and unusually powerful-looking class of ships with high freeboard and two widely spaced funnels. They are generally known as the 'County' Class and because of their size were soon uprated from destroyers to destroyer-leaders (DLGs) to correspond with the similar regrading in the US Navy.

In the year that HMS *Devonshire* joined the Fleet a further pair were laid down, followed by another pair four years later. It had always been recognized that their traditional cruiser-names indicate that the RN regards them as light cruisers, and that 'destroyer' was a fiction to secure Parliamentary approval.

The 'Counties' had a Combined Steam and Gas Turbine (COSAG) propulsion system similar to, but double that in the 'Tribal' Class frigates. Two sets steam turbines and four G.6 gas turbines were geared to two shafts. The gas turbines could start from cold within a few minutes, allowing the ships to get underway without waiting for steam, or

Devonshire

HMS *Fife* (D.20) leads nine surface vessels and two submarines into Gibraltar harbour prior to an exercise in 1975. With *Glamorgan, Antrim* and *Norfolk* she carries the more powerful Seaslug II system. All the vessels are fitted with stabilizers and are fully air-conditioned. Their original cost varied from £13.8 million for *Hampshire* to £16.8 million for *Antrim*. Four MM.38 Exocet missiles have been fitted to *Norfolk, Antrim, Glamorgan* and *Fife*



Royal Navy

providing high-speed boost. The steam plant was forward, while the gas turbines vented through the fat after funnel.

The ships were built around the Armstrong-Whitworth Seaslug Guided Weapon System No 1 (GWS1), and were the first RN ships armed with guided missiles. As procurement was under the control of the old Ministry of Supply there were many unusual features, notably the very large and bulky twin-ramp launcher. Horizontal stowage was adopted on account of Seaslug's bulk, and the magazine was positioned below the waterline just abaft the forward funnel and engine room. From here the missiles were taken up to shelter deck level, and then travelled aft for fitting fins, warm-up, check-out etc, through the split gas turbine exhausts, and then out to the launcher on the quarterdeck. The normal stowage is 16 missiles, and fresh rounds can be embarked while underway.

When completed the eight ships were basically similar, but the last four had a thinner formast and a twin Type 965 AKE or 'double bedstead' air-warning radar aerial on the mainmast. They were also armed with the more powerful Seaslug Mk 2, which has a limited surface-to-surface capability, but no external difference can be detected. In 1973

Aérospatiale

HMS *Norfolk* fires an MM.38 Exocet from one of the launchers replacing B turret

Norfolk underwent conversion to carry four Exocet MM.38 surface-to-surface missiles, and lost B gun-mounting. She carried out firing trials in the French Mediterranean in April 1974, and since then *Glamorgan, Fife* and *Antrim* have been similarly fitted.

The first four ships saw active service during the confrontation with Indonesia in 1964, where it was belatedly realized that these large and expensive ships could be knocked out with relative ease by a man in a sampan armed with a bazooka. As a tempor-

No and name	launched	builder
D.02 *Devonshire*	6/1960	Cammell Laird, Birkenhead
D.06 *Hampshire*	5/1961	John Brown, Clydeside
D.12 *Kent*	9/1961	Harland & Wolff, Belfast
D.16 *London*	12/1961	Swan Hunter, Wallsend
D.19 *Glamorgan*	7/1964	Vickers-Armstrongs, Tyne
D.20 *Fife*	7/1964	Fairfield Shipbuilding, Govan
D.18 *Antrim*	10/1967	Fairfield Shipbuilding, Govan
D.21 *Norfolk*	11/1967	Swan Hunter, Wallsend

ary expedient old 20-mm (0.79-in) Oerlikon guns were fitted on either side of the bridge, but these have been retained ever since as a useful Cold War weapon.

HMS *Hampshire* paid off in April 1976, about seven years before the expected end of her operational life. The Seaslug beam-rider is not suited to modern aerial engagements, and can only engage a maximum of four targets. The COSAG propulsion system is complex, and the ships require large crews, but their command facilities make them very useful as flagships for task groups. The *Devonshire*, *Kent* and *London* were expected to be scrapped by 1980.

See also *Ashanti, Daring,* Seaslug.

Displacement: 5440 tons (standard), 6200 tons (full load) *Length:* 158.6 m (520 ft 6 in) oa *Beam:* 16.4 m (54 ft) *Draught:* 6.1 m (20 ft) *Machinery:* 2-shaft geared steam turbines, 15000 shp+gas turbines, 15000 shp=32½ knots *Armament:* 1 Seaslug GWS1 SAM launcher; 2 Seacat GWS22 quadruple SAM launchers; 4 4.5-in (114-mm) Mk 6 (2×2), or 2 4.5-in (114-mm) (1×2); 4 Exocet MM.38 SSM launchers; 2 20-mm (0.79-in) Oerlikon guns (2×1) *Aircraft:* 1 Westland Wessex helicopter *Crew:* 471

Dewlap

British torpedo. Projected at the end of the Second World War, Dewlap was the fifth and final member of the so-called 'Z-Weapons', which were intended to provide the British armed forces with a series of revolutionary weapons. Dewlap was a 53-cm (21-in) torpedo intended for use in motor torpedo boats. However, in common with its fellow-projects, it was wildly unrealistic, and was cancelled about 1949 without reaching even the test-stage.

Dewoitine French aircraft See **D.1, D.9, D.21, D.27, D.37, D.500/510, D.520**

De Zeven Provincien

Dutch coast defence ship, built 1908-1910. This ship was the first of a series of 5000-ton ships armed with two single guns and a speed of 16 knots, intended for the defence of the East Indies. The Royal Netherlands Navy never built 1st Class battleships, and in some navies these ships would have been rated as armoured cruisers.

She was built by the Amsterdam dockyard, laid down in February 1908 and launched in March 1909. *De Zeven Provincien* adopted 28-cm (11-in) guns in place of the 24-cm (9.4-in) Krupp guns previously used.

The ship is best remembered for a mutiny in 1933. A severe financial crisis in the Dutch East Indies caused the government to implement a series of wage-cuts for public servants. There was general unrest at the Soerabaja naval base early in 1933, and on February 4, while the old ship (now rated as a cruiser or armoured ship) lay at Oleh-leh in southern Sumatra, she was seized by Dutch and native sailors. They took the ship to sea next day with a view to reentering Soerabaja to incite the rest of the Fleet to mutiny and to obtain the release of a number of imprisoned sailors.

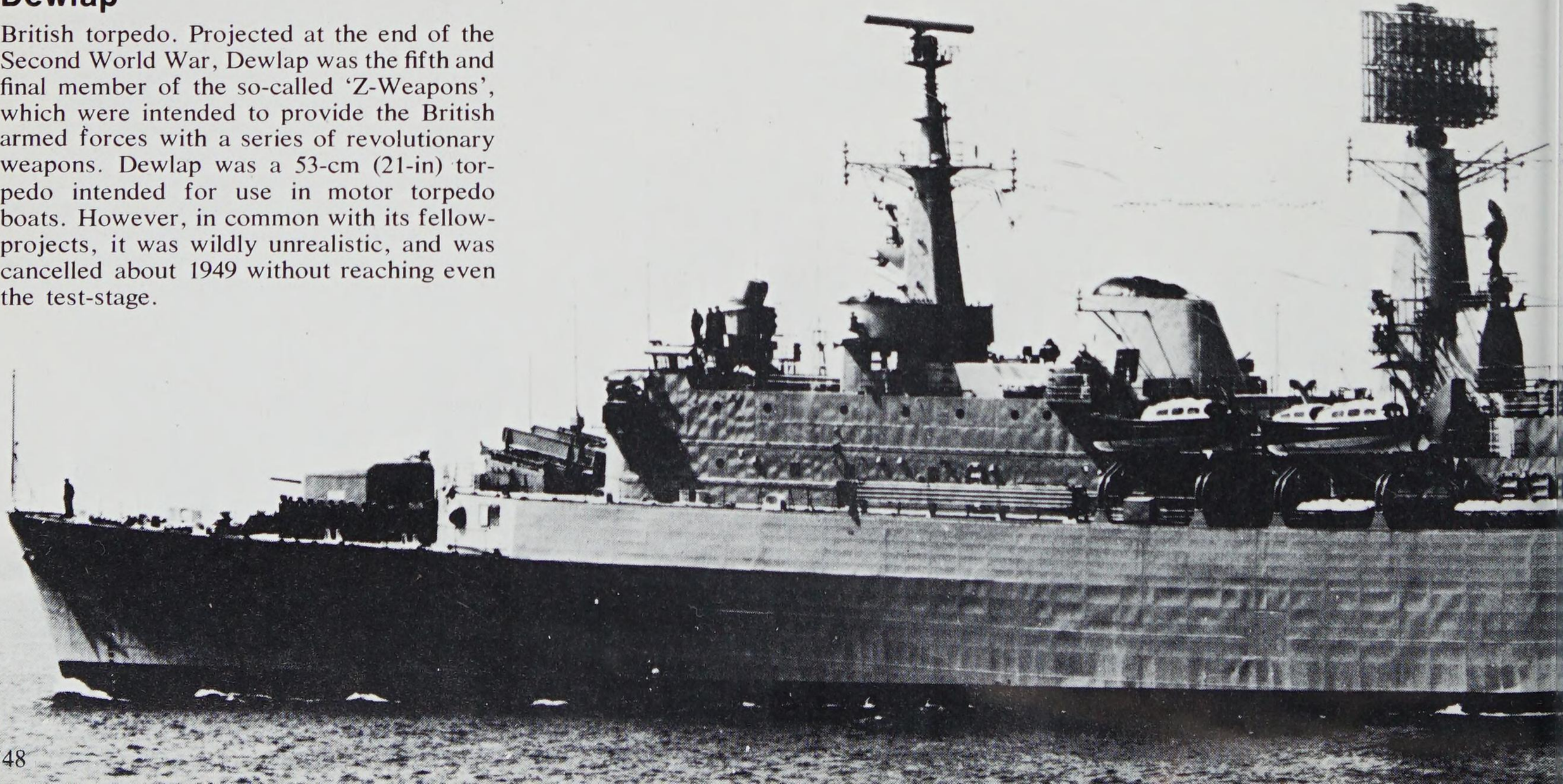
However, the rebel cruiser was cornered by a task force which included the cruiser *Java*, the destroyer *Piet Hein* and *Evertsen*, the submarines *K VII* and *K XI* and Dornier flying boats. At 0609 hrs on February 10, *De Zeven Provincien* was sighted, and at 0853 hrs the *Java* called on her to surrender. As no proper reply was received Admiral Osten ordered the Dornier flying boats to attack, and at 0918 hrs one of them dropped a 50-kg (110-lb) bomb which hit alongside the forefunnel. The effect was shattering, as the bomb exploded on the spot where the rebels were holding a council of war—19 people were killed, including the two ringleaders, and 21 were wounded. Panic ensued, and the white flag was quickly run up.

Thereafter the ship lapsed into obscurity. She was renamed *Soerabaia* to release the name for a new cruiser and was hulked as a training ship at Soerabaja. On February 18, 1942, she was damaged by Japanese bombs and then scuttled, but the Japanese raised her and used her as a blockship in 1942-43.

Displacement: 5644 tons (normal) *Length:* 103.48 m (339 ft 6 in) oa *Beam:* 17.07 m (56 ft) *Draught:* 61.17 m (200 ft 8½ in) *Machinery:* 2-shaft vertical triple-expansion 7500 ihp= 16 knots *Protection:* 102-152 mm (4-6 in) belt; 152 mm (6 in) bulkheads; 51 mm (2 in) deck; 230-203 mm (9-8 in) turrets *Armament:* (As built) 2 28-cm (11-in) (2×1); 4 15-cm (5.9-in); 10 76-mm (3-in)/55-cal (10×1); 1 9-pdr mortar; (After 1939) 2 28-cm (11-in); 2 76-mm (3-in); 6 40-mm (1.57-in) AA (6×1); 6 12.7-mm (10.5-in) machine-guns *Crew:* 447

De Zeven Provincien

Dutch light cruiser class, built 1939-53. Two cruisers, to be known as *De Zeven Provincien* and *Kijkduin*, were ordered in 1937-38 to replace the elderly *Java* and *Sumatra*. The design was developed from the *De Ruyter*,



but with considerably more gunpower and better protection.

The designed armament was to be ten 150-mm (5.9-in) guns in two triple and two twin turrets, six twin 40-mm (1.57-in) Bofors antiaircraft guns and two triple 21-in (53-cm) torpedo tubes. A catapult and two aircraft were to be provided, and a relatively high horsepower, 78 000, was installed with only two shafts, to give 32 knots. The guns were to be provided by Bofors AB and the estimated cost was to be 20 million guilders each.

The keel of the first cruiser, the *Kijkduin*, was laid on May 19, 1939, at Rotterdam, but the name was soon changed to *Eendracht*; her sister's keel was laid on September 5 at Schiedam, only two days after the outbreak of the Second World War. The invasion of the Netherlands by German troops in May 1940 gave little enough time for much work to be done on the ships, and in any case a shortage of skilled workers had delayed them. There was no time to destroy the material on the slips, and the German administration rescinded the Dutch government's order to cancel the contracts, hoping that the ships could be completed for the Kriegsmarine. Work proceeded very slowly as the Dutch Resistance did its best to delay essential materials, but apart from giving *De Zeven Provincien* a lengthened 'Atlantic' bow, no changes were made to the design. She was ready for launching by November 1944, but with a view to using her as a blockship. Fortunately the hull remained in the Wilton shipyard at Rotterdam, and fell into Allied hands.

The main armament had not been delivered from Sweden before the fall of the Low Countries in May 1940, but Bofors AB was able to sell the two triple turrets and four twins to the Royal Swedish Navy. These were then used to arm the new cruisers *Göta Lejon* and *Tre Kronor*, which were started during the war.

Although the Dutch navy was anxious to rebuild the fleet it was aware that the design of the two undamaged hulls was now quite outdated, and would need considerable redesign to bring it into line with modern requirements. Under the aegis of the original designer, G't Hooft and using technical assistance from the Royal Navy, the armament was reduced to four twin 6-in (152-mm) guns of a new Bofors design and four twin 57-mm (2.24-in) mountings, but no torpedo tubes.

Name	launched	builder
De Zeven Provincien (ex-*Eendracht*, ex-*Kijkduin*)	8/1950	Rotterdam Dry Dock company
De Zeven Provincien (ex-*Eendracht*, ex-*Kijkduin*)	12/1944	Wilt-Fijenoord, Schiedam

The new 6-in (152-mm) guns were dual-purpose, with 60° elevation and a rate of fire of 15 rds/min, while the 57-mm (2.24-in) guns were in tri-axially stabilized turrets. Six twin 40-mm (1.57-in) Bofors AA mountings of British Mk V pattern were also to be mounted, but finally eight single 40-mm (1.57-in) were chosen.

The radically different armament meant the redistribution of magazines and shell-rooms in the hull, but an even bigger change was the adoption of the 'unit' system of machinery. The original three-shaft arrangement, with six boilers in three boiler-rooms and three turbine-rooms, was replaced by a two-shaft arrangement, with four boilers and two engine rooms in two groups. Because the double boiler-rooms were now widely separated it was necessary to provide two funnels.

The original silhouette, with a single funnel and fairly light bridgework was replaced by two short upright funnels and a very big bridge. However, the need to keep fumes clear of radar and control-stations led to the funnels being raked and made much taller, and to save space the forward tripod mast was stepped over the forefunnel. When completed both ships had a lattice tripod mainmast abaft the second funnel, but this was soon shifted, and was stepped in similar fashion over the funnel, keeping gas clear of the radar arrays.

Plans were ready in 1947, and immediately work began on the cruisers once more. When the time came to launch the second ship in 1950 it was decided to transfer the name *De Zeven Provincien* to her, and to give the illustrious name *De Ruyter* to the other one.

The armament was partly provided by Bofors AB and partly built under licence in Holland, and installation was carried out in 1951. The *De Ruyter* sailed on her acceptance trials in the spring of 1953, followed by *De Zeven Provincien* in the summer. Both ships took part in a number of NATO exercises, including 'Fair Wind' in July 1956 and 'Shipshape' in September 1958.

The need for enhanced antiaircraft defence led to plans being drawn in the early 1960s to convert both cruisers to guided missile-ships, but the enormous cost and the fact that the hulls would be over 40 years old by the end of their effective lives led the Naval Staff to order the conversion of *De Zeven Provincien* only. She was taken in hand by the Rotterdam Dry Dock company. In April 1962 for conversion, and reemerged in August 1964.

The quarterdeck was built up flush with the forecastle deck and the after turrets were removed to provide space for Terrier missile magazines. The after funnel and mast were replaced by a 'mack' carrying the LW01 air-surveillance radar antenna, and a new mast was stepped further aft to carry the SPS-34 air-surveillance radar antenna. Two stumpy towers for the SPG-55 directors for Terrier guidance were also installed at the after end of the superstructure, and to compensate for all this top weight a twin 57-mm (2.24-in) turret and four single 40-mm (1.57-in) guns had to be removed.

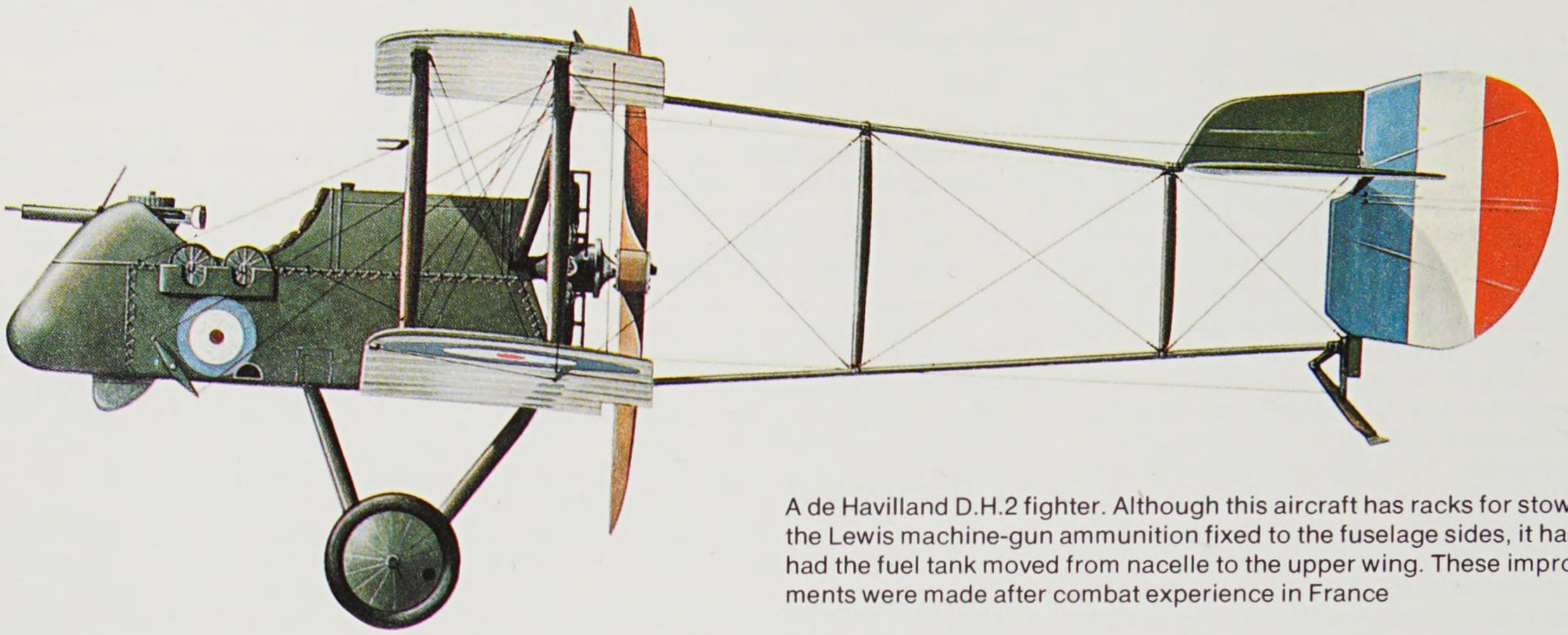
On January 26, 1973, the unmodernized *De Ruyter* was stricken, but instead of being scrapped she was immediately sold to Peru and became the *Almirante Grau*. In August 1975 the Netherlands navy announced that *De Zeven Provincien* was to be laid up as an economy measure, but a year later she was also purchased for the Peruvian navy, under the name *Aguirre*.

See also *Tre Kronor*.

(As designed 1939) *Displacement:* 8350 tons (standard), 9820 tons (full load) *Length:* 188.7 m (619 ft) oa *Beam:* 17.3 m (56 ft 9 in) *Draught:* 5.64 m (18 ft 6 in) max *Machinery:* 3-shaft geared steam turbines, 78 000 shp = 32 knots *Protection:* 76-102 mm (3-4 in) belt; 51-102 mm (2-4 in) turrets *Armament:* 10 150-mm (5.9-in)/53-cal DP (2×3, 2×2); 12 40-mm (1.57-in) AA (6×2); 8 12.7-mm (0.5-in) machine-guns (4×2); 6 53-cm (21-in) torpedo tubes (2×3) *Crew:* 700

The *Devonshire* Class destroyer HMS *Glamorgan* after conversion to carry Exocet missiles. The Seaslug II launcher is just aft of the helicopter flight deck

C & S Taylor



A de Havilland D.H.2 fighter. Although this aircraft has racks for stowing the Lewis machine-gun ammunition fixed to the fuselage sides, it has not had the fuel tank moved from nacelle to the upper wing. These improvements were made after combat experience in France

(As completed 1953) *Displacement:* 9529 tons (standard), 11 850 tons (full load) *Length:* De *Zeven Provincien* 118.7 m (389 ft 5¼ in) oa, *De Ruyter* 190.3 m (624 ft 4 in) oa *Beam:* 17.3 m (56 ft 9 in) *Draught:* 6.7 m (22 ft) *Machinery:* 2-shaft geared steam turbines, 85 000 shp=32 knots *Armament:* 8 6-in (152-mm) DP (4×2); 8 57-mm (2.24-in) AA (4×2); 8 40-mm (1.57-in) AA (8×1); (*De Zeven Provincien* 1964) 4 6-in (152-mm) DP (2×2); 6 57-mm (2.24-in) AA (3×2); 4 40-mm (1.57-in) AA (4×1); 1 twin Terrier RIM-2 SAM system *Crew:* 700

DFS 230

German assault glider. The major contribution of the Deutsches Forschungsinstitut für Segelflug (German Research Institute for Gliding) to Germany's Second World War armoury was the DFS 230 assault glider. With a rectangular-section fabric-covered steel-tube fuselage, and a long tapering wing covered in plywood and fabric and braced by metal struts to the fuselage, the glider could carry some 272 kg (600 lb) of freight in addition to the pilot plus nine troops and their equipment. Three prototypes were built and tested by the DFS, and further DFS 230s were produced by Gothaer Waggonfabrik, a series of A-O pre-production models being followed by production A-1s and dual-control A-2s. Deliveries began in October 1939. Some modifications were incorporated in the B-1 and B-2 production series, notably a parachute pack for braking, a stronger landing skid and a mounting for a single MG 15 machine-gun.

The DFS 230 made its operational debut in the attack on Fort Eben Emael and Albert Canal bridges in Belgium and Holland in May 1940. It went on to take part in attacks on the Corinth Canal, and in the airborne invasion of Crete in May 1941. However, such heavy losses were suffered during the later operation that thereafter DFS 230s were largely confined to transport duties in the Mediterranean and on the Eastern Front. One other spectacular operation involved DFS 230s, however, when DFS 230c-1s—B-1s fitted with forward-firing braking rockets in a special nose cone—were used to land German commandos on the Matto Grosso as part of the rescue of Italian leader Benito Mussolini. A total of over 1500 DFS 230s were produced, and the glider soldiered on in the supply role almost until the end of the war.

(230B-1) *Span:* 21.98 m (72 ft 1¾ in) *Length:* 11.24 m (36 ft 10½ in) *Gross weight:* 2100 kg (4630 lb) *Maximum speed:* 290 km/h (180 mph)

D.H.1/1A, de Havilland

British fighter and reconnaissance aircraft. Following two not altogether successful designs from Geoffrey de Havilland in 1909 and 1910, he piloted the prototype D.H.1 on its first flight in early 1915. It was a two-seat pusher biplane with the observer in the front cockpit, which also housed a forward-firing machine-gun. Powered by a 70-hp Renault engine, instead of the originally specified 120-hp Beardmore powerplant (these being more urgently required for the F.E.2b and R.E.5), a creditable performance was achieved and an order for 100 D.H.1s was placed with Savages of Kings Lynn. Production models differed from the prototype in having dual controls, a modified nacelle, reinforced bracing wires and a simplified undercarriage.

Beardmore engines eventually became more plentiful and with this powerplant the type was designated D.H.1A. In spite of an all-up weight increase of nearly 136 kg (300 lb), including a 10% additional fuel load, it was 13 km/h (8 mph) faster than the D.H.1 and had a more rapid rate of climb. Although more manoeuvrable and responsive than the contemporary F.E.2b, only 73 D.H.1/1As were delivered to the RFC and these were utilized mainly on home defence and training duties. No 14 Squadron had six D.H.1As which were operational in Palestine from the summer of 1916 on escort duty. Some survived in Britain until 1918, but all had been withdrawn from service before the Armistice. Why it was not used as a fighter to defeat the 'Fokker scourge' has not been explained.

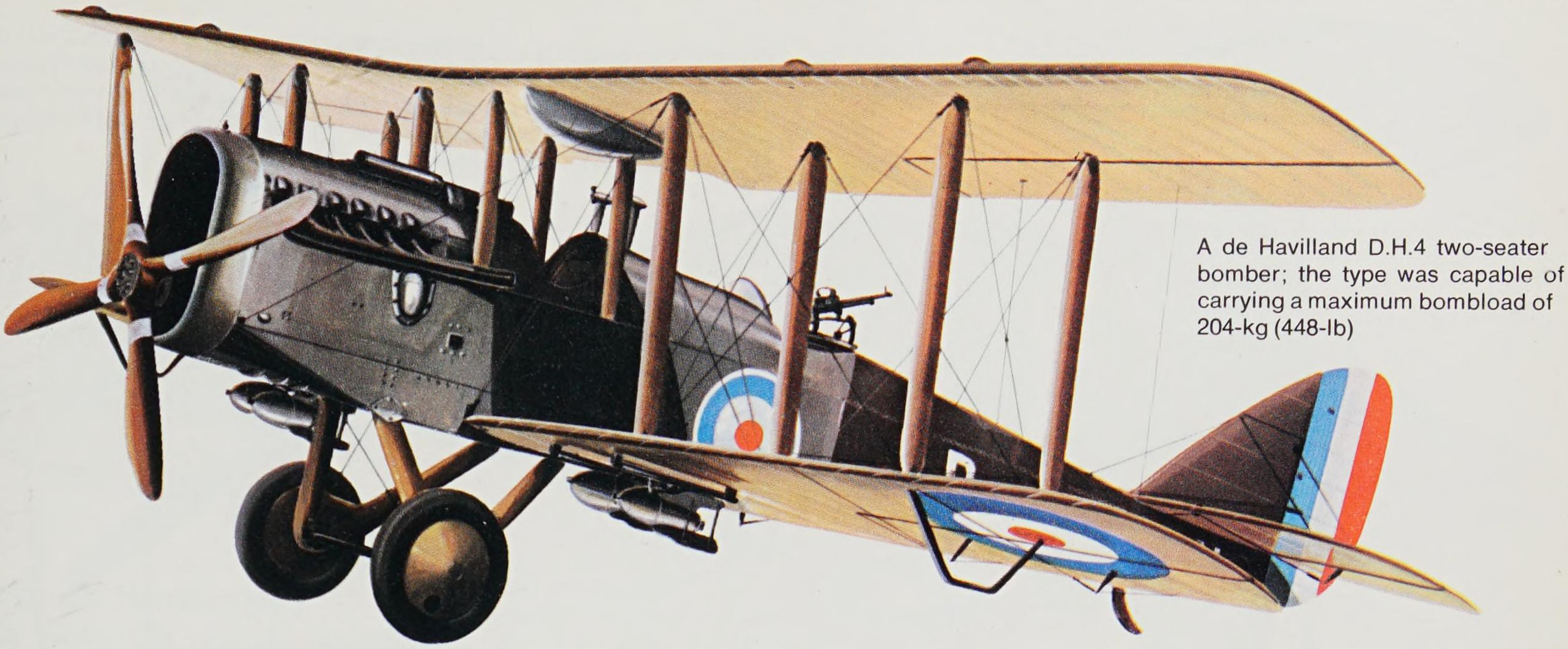
(D.H.1A) *Span:* 12.50 m (41 ft) *Length:* 8.82 m (28 ft 11¼ in) *Gross weight:* 1061 kg (2340 lb) *Maximum speed:* 142 km/h (88 mph)

D.H.2, de Havilland

British fighter aircraft. Basically a scaled-down version of the D.H.1, and again of pusher layout, since no British machine-gun interrupter gear was available at that time, the D.H.2 was the first de Havilland-designed single-seat fighter.

A sturdy, compact and conventional two-bay biplane, it began testing in the spring of 1915, powered by a 100-hp Gnome Monosoupape engine. It was armed with a single Lewis machine-gun, mounted on a pivoted bracket on the left side of the cockpit, and all the fuel was in one tank within the nacelle.

A D.H.2 with the gravity feed fuel tank slung beneath the upper mainplane on the port side



A de Havilland D.H.4 two-seater bomber; the type was capable of carrying a maximum bombload of 204-kg (448-lb)

After trials in Britain, the prototype was issued to No 5 squadron RFC in France for further testing, but came to an untimely end following enemy action on August 9, 1915. In spite of this ignominious beginning, the D.H.2 was considered worthy of series production and initial deliveries began in late 1915 to No 24 Squadron, which was sent to France in February 1916 with 12 D.H.2s as the first-ever British squadron to be equipped with single-seat fighters.

The Lewis gun on these aircraft (to which the windscreen was attached) was installed on a central pivot mounting; this was completely free-moving, so that the gun could be moved upwards and downwards and to the right or left. With its small speed range and sensitive controls the D.H.2 caused some handling problems for pilots initially, but once these had been overcome it was accepted as a highly robust and manoeuvrable little fighter.

Modifications were made to the nose of the nacelle; the ammunition was carried in drums on external racks on each side of the cockpit; and the revised fuel system comprised a gravity tank fitted either under or on top of the upper mainplane on the port side. Production models retained the Gnome engine, as comparative trials with a 110-hp Le Rhône 9J powerplant revealed that this gave an inferior performance.

In service, the mobility of the Lewis gun was eventually found to be something of a hindrance and it was consequently stabilized and fixed to fire forward along the line of flight, so that the pilot had to aim his aircraft at the target. Thus equipped, the D.H.2 fighter did more to repel the marauding German Fokker monoplanes than any other British aircraft in service at that time and was issued in 1916 to Nos 5, 11, 18, 29 and 32 Squadrons.

Of the 400 D.H.2s built, about two-thirds were sent to France, but unfortunately by autumn 1916 they were being heavily outclassed by German Halberstadt and other biplane fighters. Major L G Hawker, VC, DSO, was killed when his D.H.2 was shot down by the legendary von Richthofen in an Albatros D.II on November 23, 1916. Earlier, on July 1, 1916, the commanding officer of No 32 Squadron had earned the VC for an outstanding single-handed action against ten German two-seaters, in which he forced down two of the enemy and scattered the remainder, causing them to abandon their raid.

Phasing out of the D.H.2 began in France in March 1917, though D.H.2s serving in Palestine with No 11 Squadron, and with No 47 Squadron and a joint RFC/RNAS squadron in Macedonia, had a slightly longer service life. Two were evaluated at Home Defence stations in Britain in 1917, but were unable to cope with the Zeppelin raiders. After being withdrawn from front-line service, many D.H.2s were sent to British training units, where they served until 1918.

Span: 8.61 m (28 ft 3 in) *Length:* 7.68 m (25 ft 2½ in) *Gross weight:* 654 kg (1442 lb) *Maximum speed:* 150 km/h (93 mph)

D.H.4, de Havilland

British bomber. The two-seat D.H.4 was the first British aircraft designed from the outset as a fast day bomber, and it became one of the First World War's most useful and respected combat types. Fifty were ordered in the summer of 1916, before the prototype had flown. This had a 160-hp BHP engine, but 250-hp Rolls-Royce IIIs or IVs (later known as Eagles) were fitted to production aircraft.

Production aircraft also embodied improvements introduced by the second prototype, including a ring mounting for the observer's Lewis gun in the rear cockpit; a forward-firing Vickers gun, with a Constantinesco synchronizing gear, was fitted in front for the pilot. Some RNAS D.H.4s had twin Vickers and an elevated Scarff ring for the Lewis. Maximum bombload comprised two 104-kg (230-lb), four 51-kg (112-lb) or an equivalent weight of smaller bombs.

Deliveries to the RFC began in early 1917, and subsequent production in Britain amounted to some 1450, built by seven manufacturers. Rolls-Royce engine production

The D.H.4 bomber was one of the most successful aircraft of the First World War, serving in France, Italy, the Aegean and Palestine. Some 600 American-built versions saw action in France

D.H.5, de Havilland

An American-built D.H.4 of No 50 Squadron AEF. These aircraft , the only British type to be built by the Americans, were powered by a 400-hp Liberty 12 engine and so collected the name 'Liberty Plane'. The US Government ordered over 12 000, but only 4846 were completed

could not keep pace with this, resulting in several batches of D.H.4s being fitted with such alternative powerplants as the Adriatic, Puma or RAF.3a (all 200-hp) or the Fiat A-12 (260-hp). Highest performance was achieved with the Rolls-Royce Eagle VIII (375-hp), which gave the D.H.4 a top speed of 230 km/h (143 mph).

The first Royal Flying Corps D.H.4 Squadron, No 55, arrived in France with these aircraft in March 1917, making its first operational sortie in April. At about the same time No 2 Squadron of the Royal Naval Air Service began to operate the D.H.4, and eventually some 11 squadrons of the RFC or RNAS (or, from April 1, 1918, the RAF) were equipped with them.

During their career D.H.4s were used for many duties besides day bombing. These included artillery spotting, antisubmarine patrol, and photographic reconnaissance. They served mainly on the Western Front, but also in some numbers in Russia, Macedonia, Mesopotamia, the Adriatic and the Aegean. At home, they were also employed as trainers and coastal patrol aircraft. Two were fitted out experimentally with extra fuel tanks, enough to give 14 hours' flying, and were intended to carry out a special photographic reconnaissance of shipping in the Kiel Canal. This mission never took place, but the two D.H.4s were later fitted instead with twin over-wing Lewis guns and used for night fighting.

The D.H.4. was withdrawn from RAF service soon after the Armistice, and in the early postwar years many were supplied to the air forces of Belgium (where SABCA also built a small number), Canada, Chile, Greece, Persia, New Zealand, South Africa and Spain. Some remained in service until the early 1930s, and others were converted for civil use in the 1920s.

Highest production of all, however, took place in the USA where, in the summer of 1917, a pattern aircraft had been fitted with a 400-hp Liberty 12 engine. The US government ordered more than 12 000 of these 'Liberty Planes', although 7502 were cancelled after the Armistice. Nevertheless, a total of 4846 were completed—by Dayton-Wright (3106), Fisher Body Division of General Motors (1600) and Standard Aircraft Corporation (140). Only about 30% of these reached France before the end of the war, but they were the only American-built British warplanes to see combat service in the First World War and equipped 13 squadrons of the American Expeditionary Force (from August 1918) and four squadrons of the US Naval Northern Bombing Group.

The Americans were never truly happy with this initial version, which they designated DH-4A. It was obsolescent by the time it entered US service, having had to be reworked to suit it to US production techniques, and the improved DH-4B was ready too late (October 1918) to take its place on the Western Front. American-built DH-4As were armed with two Marlin or Browning machine-guns in the front and two Lewis guns in the rear cockpit, and could carry up to 150 kg (332 lb) of bombs. After the war, 283 of the Army's DH-4As were transferred to the US Navy or Marine Corps.

After the war a considerable building and conversion programme (of more than 1500 DH-4As) kept the DH-4B, DH-4M (for Modernized) and other later variants in US service until 1932. The DH-4B at last rectified an innate fault of the original D.H.4, by relocating the main fuel tank (previously between the two cockpits) in front of the pilot's cockpit. Boeing built 150 DH-4Ms for the US Army and 30 O2B-1s for the Marines; Fokker Atlantic Aircraft built 135 DH-4Ms.

(D.H.4/Eagle III) *Span:* 12.92 m (42 ft 4¾ in) *Length:* 9.35 m (30 ft 8 in) *Gross weight:* 1503 kg (3313 lb) *Maximum speed:* 188 km/h (117 mph)

D.H.5, de Havilland

British fighter/ground attack aircraft. The initially unarmed prototype, A5172, was built in late 1916 in an attempt to produce an aircraft combining the pilot advantage of a pusher layout with the superior performance of a tractor biplane. Powered by a 110-hp Le Rhône 9J rotary engine, it was sent to France for service trials in December 1916, armed with a forward-firing Vickers gun fixed to move upwards through a 60° arc.

After a satisfactory performance report the D.H.5 was ordered into production—549 were built by Airco (the de Havilland-owned Aircraft Manufacturing company); the Darracq Motor Engineering company; March, Jones & Cribb; and the British Caudron company. These differed from the prototype in having the fixed 0.303-in (7.7-mm) Vickers gun fitted with Constantinesco interrupter gear. Deliveries to Nos 24 and 32 Squadrons in France began in May 1917.

However, D.H.5s gave only mediocre performance above 3048 m (10 000 ft), which detracted from the fighter-role potential, and pilots did not like the backward-staggered wings. Nevertheless, their robust construction and low-level capabilities, together with a load of four 11-kg (25-lb) Cooper bombs, made them suitable for ground attack, and D.H.5s were put to such use in the battle of Cambrai in autumn 1917.

By this time S.E.5as had begun to replace D.H.5s and their first-line service life of eight months had ended by January 1918, after which they were used for training in Britain. One D.H.5 was experimentally fitted with a 45° upward-angled Vickers gun—possibly as an anti-Zeppelin measure, though no D.H.5s were used for Home Defence.

Span: 7.82 m (25 ft 8 in) *Length:* 6.71 m (22 ft) *Gross weight:* 677 kg (1492 lb) *Maximum speed:* 164 km/h (102 mph)

D.H.9/9A, de Havilland

The de Havilland D.H.5 had wings designed with an exaggerated back stagger to give the pilot a better view in action. However, it was unpopular as a fighter and was relegated to ground attack work

D.H.6, de Havilland

British trainer and antisubmarine aircraft. Resulting from the RFC's urgent requirement for a trainer in autumn 1916, the D.H.6 was an angular two-seat biplane, lacking the usual de Havilland style, but easy to build and maintain, with a good record of safety in the air. Two prototypes, A5175 and A5176, were built, each with a communal tandem-seat cockpit, and powered by a 90-hp RAF.1a air-cooled V-engine. The four rectangular wing panels were interchangeable, as were the tailplane halves.

Production of 2950 by several British companies (900 of them by Airco) began in January 1917. Most of these retained the RAF (Royal Aircraft Factory) powerplant, but some utilized a cowled 90-hp Curtiss OX-5 or an 80-hp Renault. With the advent of the Avro 504 as the standard British trainer, D.H.6s began to be phased out of the RFC in late 1917, but 200 or so were put into service in early 1918 with 34 flights of the RNAS (five operated by the US Navy) on antisubmarine coastal patrol.

Flown as single-seaters, they could carry only a 45.5-kg (100-lb) bombload, but were a useful deterrent nonetheless. About 70 D.H.6s were sent to RFC Home Defence units in 1918, though probably for liaison rather than actual fighting. The RAF possessed 1050 of the type in October 1918, and more than 50 were put on to the civil register after the Armistice.

Span: 10.95 m (35 ft 11 in) *Length:* 8.32 m (27 ft 0½ in) *Gross weight:* 919 kg (2026 lb) *Maximum speed:* 106 km/h (66 mph)

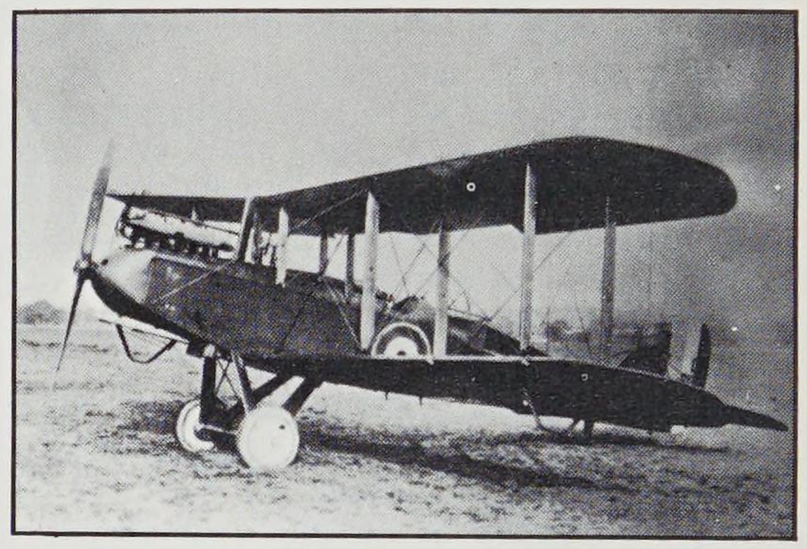
D.H.9/9A, de Havilland

British bomber. Intended as a successor to the D.H.4, the D.H.9 was evolved when, in 1917, it was decided to more than double the size of the Royal Flying Corps in France, with the main objective of stepping up the daylight bombing of Germany. Unfortunately, in its initial form at least, its performance was not as good as that of the type it was meant to replace, mainly due to difficulties encountered with the powerplant used. Apart from this, the D.H.9 was an improvement over the D.H.4 in having the two cockpits close together instead of being separated, as in the D.H.4, by the fuselage fuel tank. This made pilot/observer communication during flight much easier, and the fuel tank became less vulnerable to gunfire, since it was protected to some extent by the wing structure.

The D.H.9 was a pleasant aircraft to fly, right from the first flight of the prototype (a converted D.H.4), which was made in November 1917 with a 230-hp Galloway Adriatic engine. During the previous autumn the War Office had amended contracts for 900 D.H.4s to specify the D.H.9 instead, and production, during and after the First World War, eventually reached more than 4000, by no fewer than 15 British manufacturers, of which 3204 were built before the end of 1918.

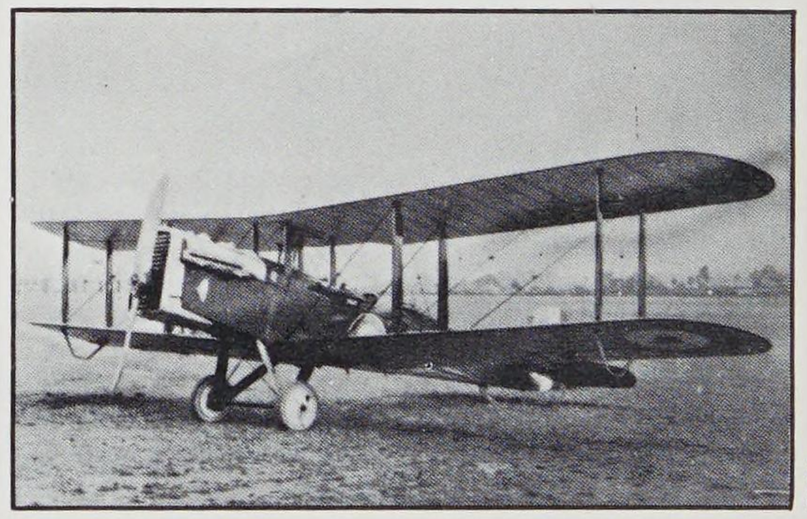
Most D.H.9s were fitted with 230, 240 or 290-hp Siddeley Puma engines, although one small batch, built by Shorts, had 260-hp Fiat A-12s. Armament comprised a front-mounted, forward-firing 0.303-in (7.7-mm) Vickers machine-gun, with Constantinesco synchronizing gear, and a 0.303-in (7.7-mm) Lewis gun on a Scarff ring mounting in the rear cockpit. Normal bombload consisted of two 104-kg (230-lb) or four 51-kg (112-lb) bombs, which could be carried internally (though they seldom were) or externally, on fuselage or lower-wing racks. Camera or W/T equipment was also installed.

Deliveries of the D.H.9, to No 103 Squadron of the RFC, began in December 1917, and the first operational sorties (by No 6 Squadron) were carried out in France in the follow-



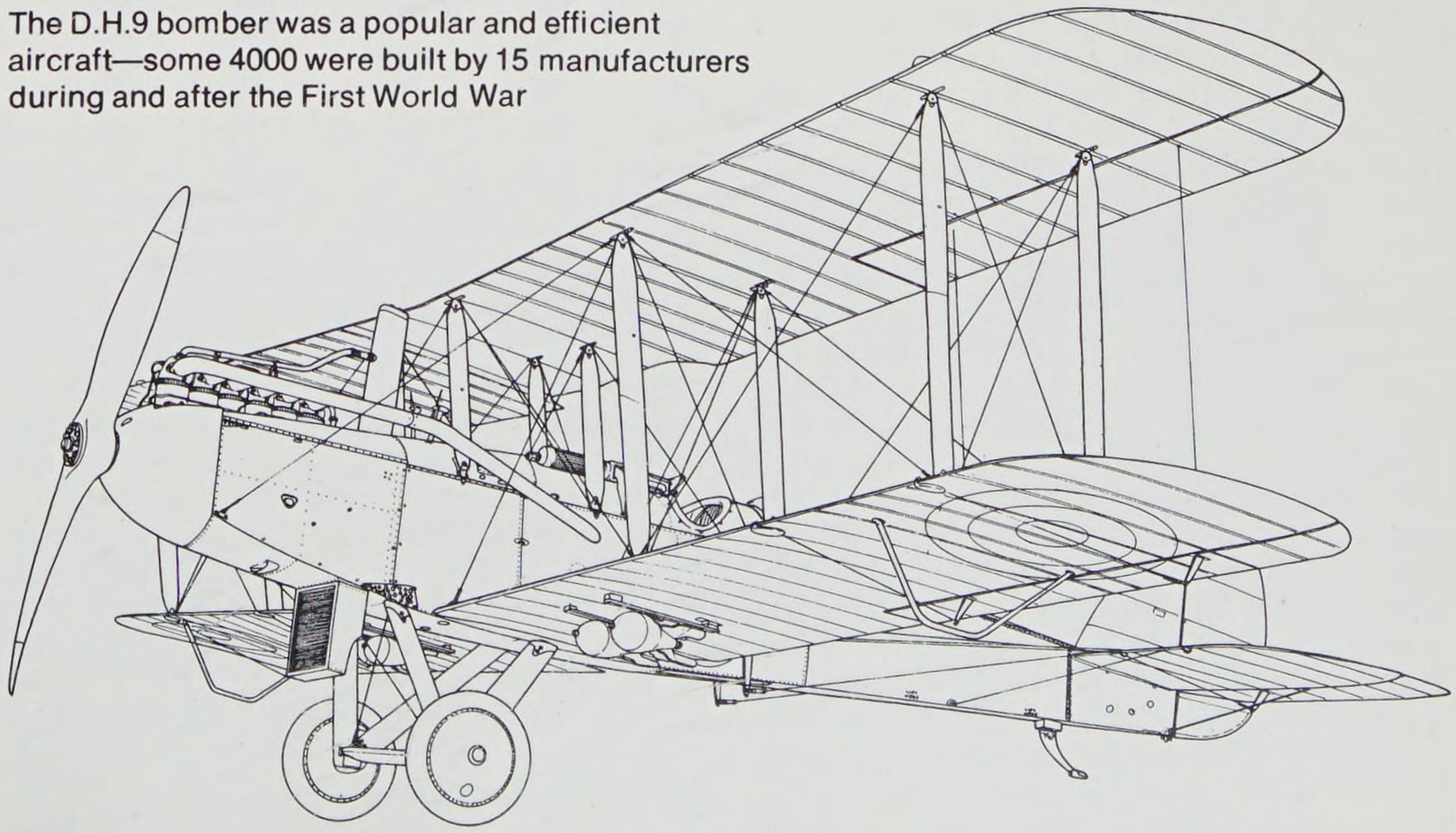
IWM

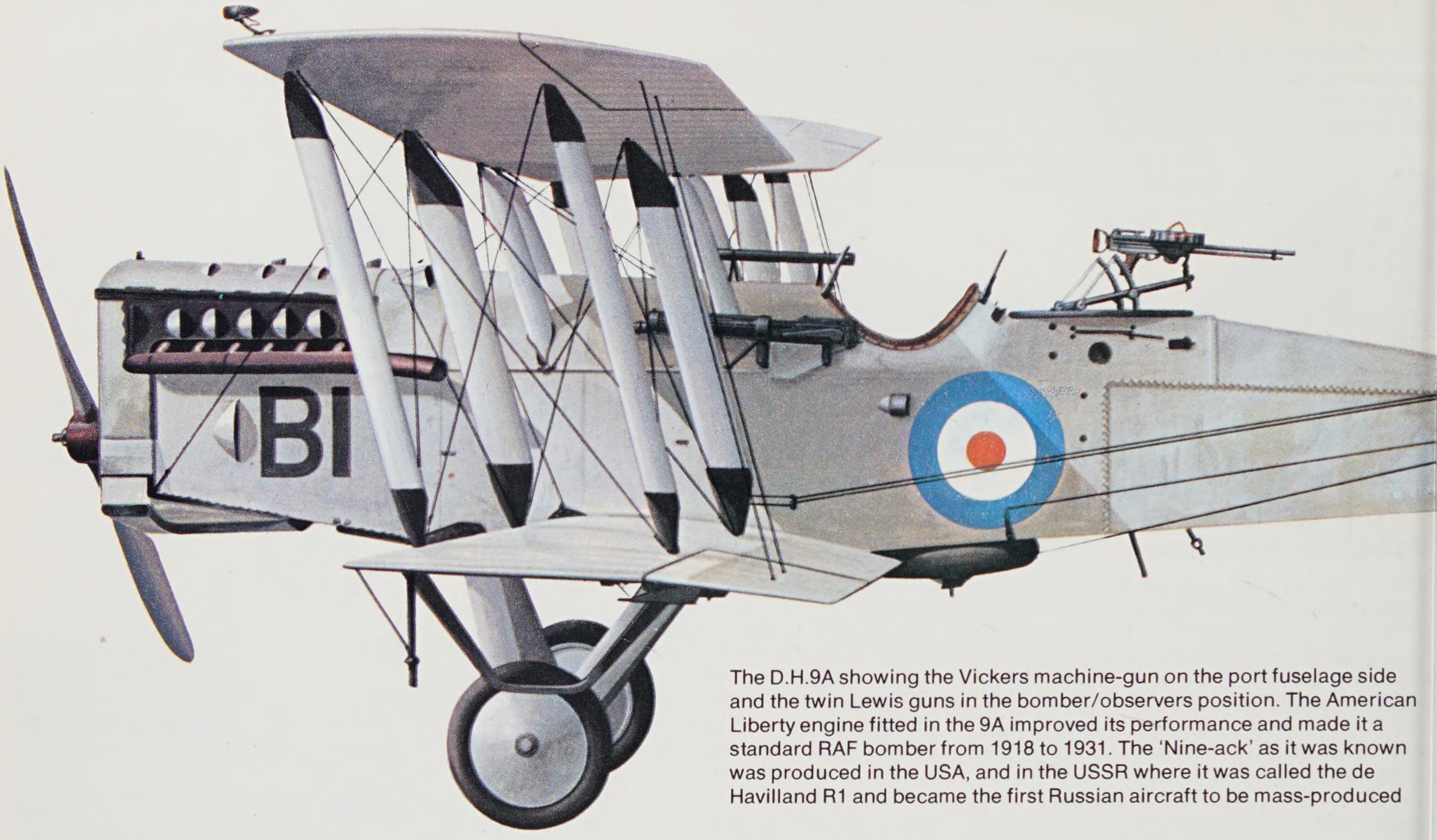
Above: **A D.H.9 with BHP engine.**
Below: **A D.H.9A powered by a Liberty engine**



IWM

The D.H.9 bomber was a popular and efficient aircraft—some 4000 were built by 15 manufacturers during and after the First World War





The D.H.9A showing the Vickers machine-gun on the port fuselage side and the twin Lewis guns in the bomber/observers position. The American Liberty engine fitted in the 9A improved its performance and made it a standard RAF bomber from 1918 to 1931. The 'Nine-ack' as it was known was produced in the USA, and in the USSR where it was called the de Havilland R1 and became the first Russian aircraft to be mass-produced

ing March. Over the next few months their activity was stepped up quite considerably, but with operations affected by the lack of power from their Puma engines, or made abortive by repeated engine failures, their successes were due more to their crews' perseverance than to the D.H.9 itself.

By the time the prototype flew, in fact, Trenchard had already asked for its cancellation, but production was already well advanced and there was no immediate substitute. The D.H.9 thus remained in service until the Armistice, equipping a dozen RFC/RAF squadrons in France and others in the Middle East, the Mediterranean and Russia.

A vast American production programme of USD-9s (the US designation of the Liberty-engined version) was planned, even bigger than that for the DH-4A, but of the 14 000 ordered only four were completed. However, following the installation of a 400-hp Liberty in a British testbed, 3000 Liberty engines were ordered from the USA to power the refined D.H.9A for the RAF. Only 1050 of these engines reached Britain, in early 1918, from which 885 D.H.9As were powered before the end of the war.

Apart from the powerplant, the chief differences from the D.H.9 were larger-area wings (to offset the bigger and heavier American engine) and a redesigned forward fuselage; armament and bombload remained unchanged. Deliveries were made from June 1918, initially to No 110 Squadron, but only two squadrons in France and two in Russia had become fully operational with them before the Armistice. Mass production, by a dozen British manufacturers (chiefly de Havilland and Westland), continued after the war; deliveries continued until 1928, and the total built eventually reached nearly 2500. Others, with various engines, were built in Spain, the USSR and elsewhere.

With the Liberty engine, the D.H.9's basic design was vindicated, and the 'Nine-Ack' (or 'Ninak') established a fine reputation with the post-war RAF at home, in the Middle East and in India. It saw action in the Afghan war which began in 1919; the war of 1919-20 between the Bolsheviks and the White Russians; in the conflicts in the 1920s in Mesopotamia/Iraq; against the Turks at Constantinople in 1922; and against the Arabs in Palestine from 1924. It served as a bomber, air ambulance, survey aircraft, air mail transport and, latterly, as a trainer, until phased out of RAF service in 1931. Those of the SAAF continued in service until 1937. Its RAF replacement, the Westland Wapiti, was based on the same airframe.

(D.H.9, 290-hp Puma engine) *Span:* 12.92 m (42 ft 4¾ in) *Length:* 9.30 m (30 ft 6 in) *Gross weight:* 1589 kg (3503 lb) *Maximum speed:* 183 km/h (114 mph)

(D.H.9A) *Span:* 14.00 m (45 ft 11½ in) *Length:* 9.22 m (30 ft 3 in) *Gross weight:* 1914 kg (4220 lb) *Maximum speed:* 193 km/h (120 mph)

D.H.10, Airco British biplane bomber
See **Amiens**

DHC-2, de Havilland Canada Canadian light utility transport aircraft See **Beaver**

DHC-3, de Havilland Canada Canadian utility transport aircraft See **Otter**

DHC-4, de Havilland Canada Canadian short-range tactical transport aircraft
See **Caribou**

DHC-5, de Havilland Canada Canadian STOL tactical transport aircraft See **Buffalo**

DI-6, Kochergin

Soviet two-seat fighter aircraft. S A Kochergin (there are many spellings, such as Kotscherighin) was a member of Polikarpov's design bureau in the early 1930s, and was responsible for the LR ground-attack version of the R-5 and the heavily-armed TsKB-4 monoplane. The DI-6, in which V P Yatsenko played a managerial role, was intended as a versatile fighter biplane able to engage both biplanes and monoplanes with equal facility. Powered by a 710-hp Cyclone, the prototype TsKB-11 flew in late 1934. The production DI-6 had a 775-hp M-25 and carried a heavier load slightly faster.

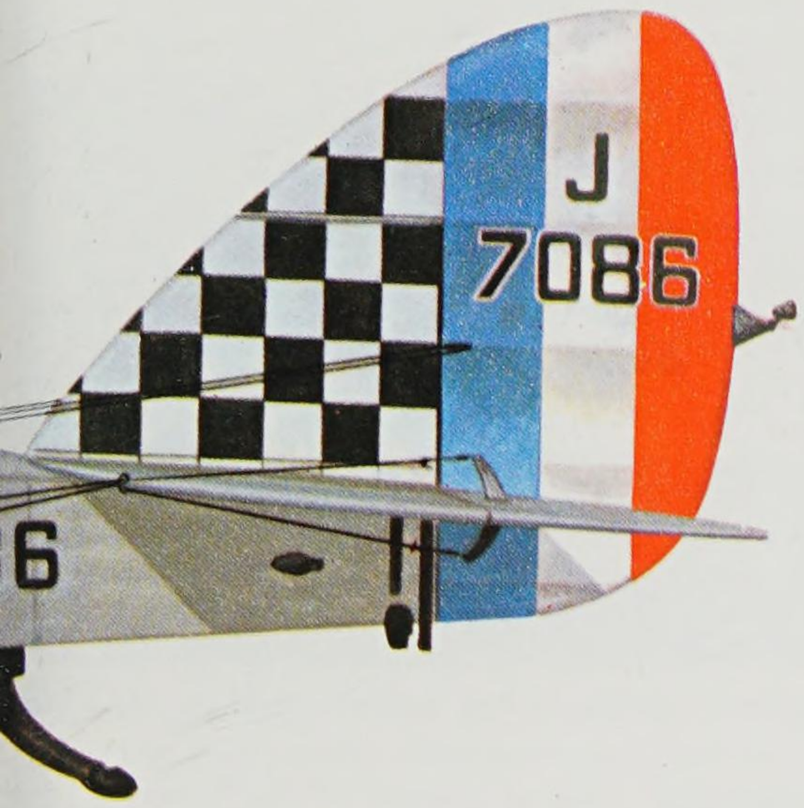
Of mixed construction, with I-type interplane struts, mainly fabric covering and inward-retracting main gears, the DI-6 had four 7.62-mm (0.30-in) ShKAS forward-firing guns, and a fifth aimed over a wide arc from the semi-enclosed rear cockpit. Underwing racks carried four 12-kg (26-lb) bombs.

Considerable numbers were built by 1937, and the DI-6 was a major Soviet type in the border wars with Japan in 1938-39. A few were in action against the Luftwaffe in 1941. A development, the DI-7 with 1000-hp M-62, did not enter production.

Span: 10.81 m (35 ft 5½ in) *Length:* 7.80 m (25 ft 7 in) *Gross weight:* 2115 kg (4663 lb) *Maximum speed:* 380 km/h (236 mph)

Diadem

British cruiser class. These four 1st Class protected cruisers were virtually reduced editions of the *Powerful* and *Terrible* with the 9.2-in (234-mm) guns omitted and thinner armour protection. They mounted a pair of 6-in (152-mm) guns, side by side, on the forecastle and quarterdeck and six 6-in (152-



mm) guns in armoured casemates on each side. They were much criticized as being under-gunned for their size and insufficiently protected. In addition, their seakeeping and handling was poor.

The *Diadem* was built by Fairfields, being laid down in 1896 and completed in 1898. She served in home waters until 1905, when she became the flagship of the Vice Admiral, China Station. She returned home in 1907 and in 1912 was placed in reserve. In 1914 she was converted into a stokers' training ship and served in this role until she was sold for scrap in 1921.

The *Andromeda* was built at Pembroke dockyard between 1895 and 1899. She had a varied career and served in the Channel Fleet, the Mediterranean Fleet, the Home Fleet and on the China Station. In 1913 she commissioned as a boys' training ship, being renamed *Powerful II*. In 1919 she was renamed *Impregnable II* and eventually paid off in 1929. However, in 1931 she was reactivated as part of the torpedo school at Devonport, under the name *Defiance I*, and survived until 1956 before being sold for scrap.

The *Europa* was constructed by J and G Thomson, being laid down in 1896 and completed in 1899. She served mainly in home waters and on the outbreak of the First World War was part of the 9th Cruiser Squadron. During 1914-15 she was employed mainly on Atlantic patrol and escort work. In July 1915 she became a virtually static flagship at Moudros in the Eastern Mediterranean, where she remained until 1919. She was sold at Malta in 1920, but sank in a gale off Corsica in January 1921. She was subsequently raised and scrapped.

The *Niobe* was built by Vickers at Barrow between 1895 and 1898. She served in home waters until 1910, when she was sold to the Canadian government for £215,000. She was paid off at Halifax, Nova Scotia, in October 1915, disarmed and served the remainder of the war as a depot ship. Her structure was severely damaged in December 1917, when the ammunition ship *Mont Blanc* blew up at Halifax. She was sold in 1922 and broken up at Philadelphia.

See also *Ariadne* Class.

Displacement: 11 000 tons (Navy List) *Length:* 142 m (466 ft) *Beam:* 21 m (69 ft) *Draught:* 7.6 m (25 ft) *Machinery:* 2-shaft triple-expansion steam engines, 16 000 ihp = 20.5 knots *Protection:* 102 mm (4 in) deck; 114 mm (4½ in) guns *Armament:* 16 6-in (152-mm) (6×1); 14 12-pdr (14×1); 4 3-pdr (4×1); 3 18-in (461-cm) torpedo tubes (submerged) *Crew:* 677

Diamond

British cruiser class. The Naval Programme of 1902-03 provided for the construction of four 3rd Class protected cruisers, the first of which, *Topaz*, was laid down in 1902 and completed in 1904. The remainder were laid down in 1903 and completed in 1905. They were the first small cruisers laid down for the Royal Navy since the late 1890s and provided the link between the designs of the old 3rd Class cruiser and the scout cruisers con-

HMS *Niobe*, a cruiser of the *Diadem* Class. She served from 1899 to 1910 with the Royal Navy and was subsequently sold to the Canadians

Beken of Cowes

structed between 1904 and 1913. Like their predecessors, they had a poop as well as a forecastle, but in most other respects their design was closer to that of the scouts. Ten of the single 4-in (102-mm) QF Mk III guns of the main armament were equally disposed down each side of the upper deck with the remaining pair mounted on the forecastle and poop. The end 4-in (102-mm) mountings on each side of the upper deck were positioned on sponsons to provide additional ahead and astern fire.

The *Amethyst* differed from her sisters in being the first British cruiser to be fitted with turbine machinery and was used for comparitive trials with the others of the class. She proved most successful and, with the same weight of machinery, achieved 23.42 knots on trial compared with 22.45 knots for *Sapphire*, the best of her sister ships. The machinery was also more economical at high speeds but at speeds of about 15 knots and less the reverse was the case. However, this situation had been anticipated and *Amethyst* was fitted with separate cruising turbines which, although they still consumed more fuel than a reciprocating engine at cruising speed, provided some improvement in economy.

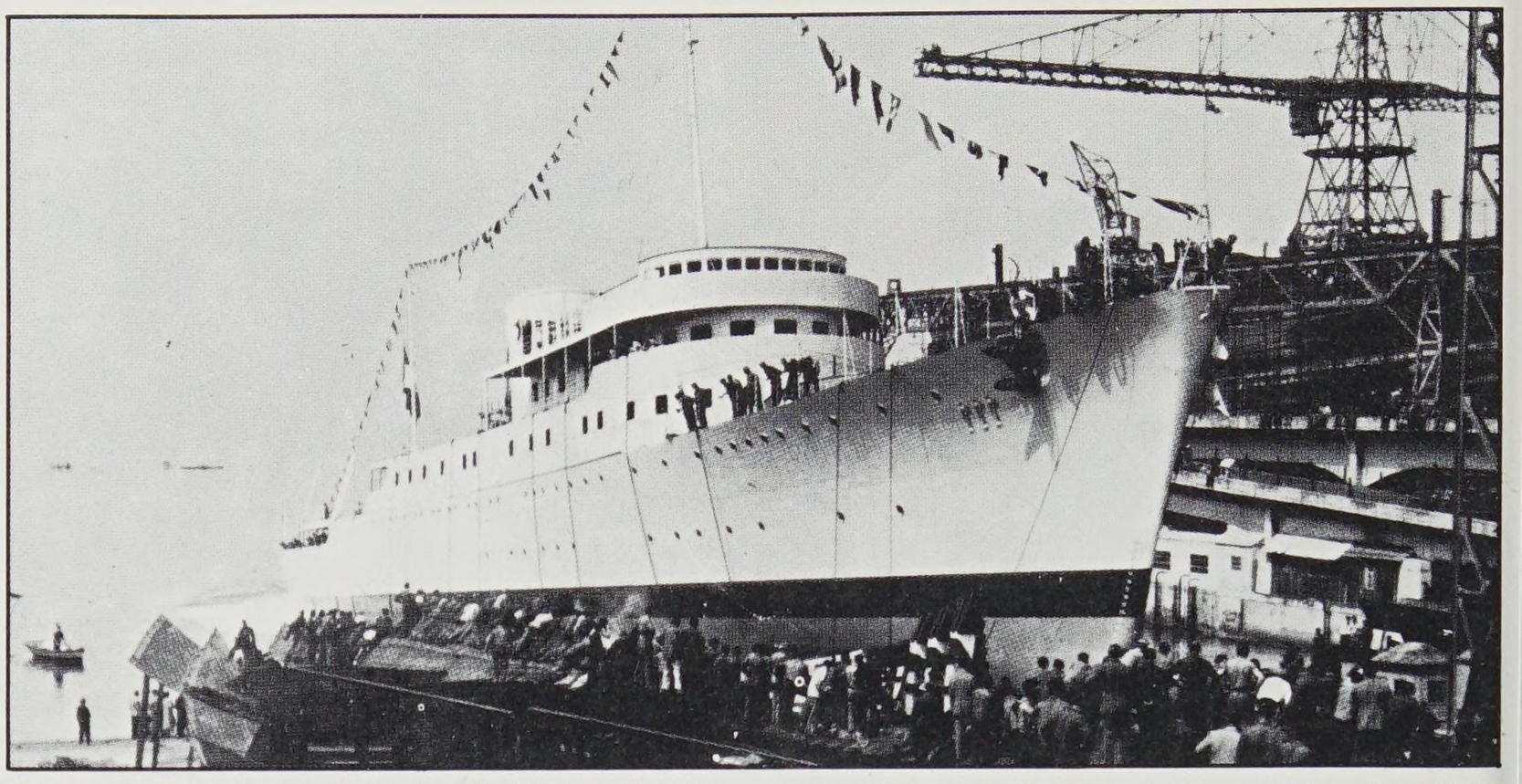
The war service of the class was comparitively uneventful. In 1914 the *Amethyst* was part of the 1st Light Cruiser Squadron at Harwich while the *Diamond*, *Sapphire* and *Topaz* were in the Channel Fleet. The *Diamond* transferred to the Grand Fleet shortly after the outbreak of war and was attached to the 5th Battle Squadron until 1915, when she transferred to the 3rd Battle Squadron. In 1918 she was converted to carry six 12.2-m (40-ft) coastal motor boats, which were hung on heavy davits amidships, and then went to the Mediterranean. The others transferred to the Mediterranean in 1915 and all three took part in the Dardanelles operation. The *Amethyst* served on the South America station and the *Sapphire* and *Topaz* in the East Indies from 1916 (*Topaz* 1917) until the end of the war. During 1916-17 the 4-in (102-mm) guns on the forecastle and quarterdeck of *Amethyst* were replaced by single 6-in (152-mm) guns and two of her midship 4-in (102-mm) guns were removed. The *Amethyst* was sold for scrap in 1920 and the remaining three in 1921.

Amethyst—built by Armstrong
Diamond, Topaz—built by Laird
Sapphire—built by Palmers.

Displacement: 3000 tons (normal), 3200 tons (full load) *Length:* 114 m (373 ft 9 in) *Beam:* 12.2 m (40 ft) *Draught:* 4.4 m (14 ft 6 in) *Machinery:* 2-shaft direct-drive turbines, 10 000 shp = 22.5 knots; *Amethyst* 3-shaft direct-drive turbines, 10 000 shp = 22.5 knots *Protection:* 51 mm (2 in) deck; 25 mm (1 in) gun shields *Armament:* 12 4-in (102-mm) (12×1); 8 3-pdr (8×1); 2 18-in (46-cm) torpedo tubes (above water, fixed) (2×1) *Crew:* 296

Diana

Italian fast sloop, built 1939-1940. This elegant ship was intended to be a despatch vessel or yacht for Il Duce, but was actually used as a fast transport, carrying high-value cargoes for the Italian armed forces.



***Diana* on the slipway at Cantieri Navali del Quarnaro, Fiume, at her launch on May 24, 1940**

The ship was ordered in 1938 from Cantieri Navali del Quarnaro at Fiume, to a design by Major-General Spinelli. It seems to have been inspired as much by Hitler's yacht *Grille* as any other design, and was given destroyer-type machinery for speed to match her rakish good looks.

Work on *Diana* started in the spring of 1939; she was launched on May 24, 1940, and almost immediately started her conversion to a fast transport. The planned armament was two 90-mm (3.5-in)/50-cal guns, but these were never mounted; in their place she was given two old 4-in (102-mm)/35-cal, one forward and one aft, and six 20-mm (0.79-in) antiaircraft guns. Mine-rails were fitted on the quarterdeck but there is no record of the *Diana* being used as a minelayer. In November 1940 she ran her trials, and on a displacement of 1923.5 tonnes reached 30 knots with 36 000 shaft horsepower.

In February 1941 the ship began a series of fast runs carrying troops and stores in the Aegean and Ionian Seas, but also acted as an escort to convoys. In July 1941 she was sent to Augusta, Sicily, for a planned attack on Malta, and she was converted to carry small explosive motor boats, known as craft, MTM or *barchini*, and to tow the slightly larger MTL torpedo-boats. On the night of July 25 the attack was launched 32 km (20 miles) north of Malta, with disastrous results for the Italians, as the defences of Malta wiped out the attackers with ease.

The *Diana* was used again to support an operation by MAS-boats (motor torpedo-boats) in the Sicilian Channel at the beginning of August, but she returned to La Spezia for repairs in November and did not return to active service until the following February. On June 28, 1942, she left Messina carrying supplies and personnel to Tobruk, but the following morning, about 120 km (75 miles) north of the Gulf of Bomba off Cyrenaica, she was hit by two torpedoes from the British submarine *Thrasher* and sank.

Displacement: (Designed) 1764 tonnes (standard), (As transport) 2063 tonnes (standard), 2695 tonnes (full load) *Length:* 114 m (374 ft) pp *Beam:* 11.7 m (38 ft 4¾ in) *Draught:* 3.86 m (12 ft 8 in) max *Machinery:* 2-shaft geared steam turbines, 30 000 shp = 32 knots *Armament:* 2 4-in (102-mm)/35-cal (2×1); 6 20-mm (0.79-in)/65-cal (6×1) *Crew:* 192

Diane

French submarine class, built 1912-17. Two submarines were ordered in 1912 for coast defence and 'blockade' duties, to a double-hulled Simonot design (Q.107-108). They were largely experimental, and *Diane* was propelled by Vickers 4-stroke diesels, while *Daphne* tried Sulzer 2-stroke motors. *Daphne* was launched in October 1915 and completed in July 1916; *Diane* was launched in September 1916 and completed in August the following year.

The design was developed from the *Gustave Zédé* (1911) but with a shorter hull, faster diving time and a much heavier armament than the preceding *Gorgone* Class. The tubes were disposed as follows: two bow tubes horizontally on the centre line, two angled out in the forward casing, two twin revolving mountings forward and aft of the conning tower, and two stern tubes.

Both boats were laid down at Cherbourg arsenal in December 1912 but work proceeded even more slowly after the outbreak of war, and they were not completed until the summer of 1916 (*Daphne*) and the summer of 1917 (*Diane*). The *Diane* was lost with all hands on the night of February 11, 1918 while escorting the big five-masted sailing ship *France*; the cause has never been firmly established, but was either an accidental explosion or a torpedo from an unidentified U-Boat.

Her sister *Daphne* received a 75-mm (0.295-in) deck gun. Between 1919 and 1924 she and other French submarines were taken in hand for reconstruction to remedy some of the glaring faults which had become obvious during war service. The most obvious changes were the replacement of the low platform by a proper conning tower and the rearrangement of the air-vents to cut the diving time. She was stricken in February 1935.

Displacement: 633/891 tonnes (surfaced/submerged) *Length:* 68 m (223 ft 1 in) *Beam:* 5.53 m (18 ft 2 in) *Draught:* 3.72 m (12 ft 2½ in) *Machinery:* 2-shaft diesel/electric, 1800 bhp/1400 shp = 17/11½ knots (surfaced/submerged) *Armament:* 75-mm (0.295-in) gun (*Daphne* only); 10 45-cm (17.7-in) torpedo tubes (4 bow, 4 in two twin revolving mountings in casing, 2 stern) *Crew:* 43

D'Iberville

French torpedo-gunboat, or *avisos-torpilleurs* class, built in 1891-95. Three vessels were ordered to the plans of Ingenieur-General de Bussy, as part of the effort to find a counter to the threat of torpedo attack on large surface warships, but the detailed design work was left to the Chantiers de la Loire private yard.

Like torpedo-gunboats of other navies they resembled small cruisers rather than large torpedo-boats, and like so many French warships of the day, all three were different. The *Cassini* was the best-looking, with taller funnels than her sisters, while the *D'Iberville* was the least handsome, with broad bases to her funnels. They also had pronounced tumblehome, and were the last French warships to have the bridge between the funnels.

Although they were of limited military value the *D'Iberville* Class gave good service, and even after 10 years' service remained capable of 20 knots. In 1904 the *Casabianca* was laid up and disarmed, and remained in reserve until 1911. The *Cassini*, on the other hand, was in commission for 12 years and in 1908 maintained a patról off Morocco after disturbances at Casablanca. During this period she steamed for 72 consecutive days, a remarkable achievement for coal-fired boilers.

The *D'Iberville* was equally active, spending two commissions on foreign stations. She was at Crete in 1898 during a crisis, and in 1907 she replaced the *Jeanne Blanche* as *stationnaire* at Constantinople (Istanbul). She was sent to Indo-China in 1908, and at the outbreak of war she was stationed at Penang on the west coast of Malaya, where she narrowly escaped being sunk by the German cruiser *Emden*. She later went to the Mediterranean, and acted as an escort off the Algerian coast until placed in reserve at Toulon in 1917. In July 1919 she was condemned and the following year was sold for scrap.

Although far too slow for the role, the *D'Iberville* was rated as a *torpilleur* or destroyer from 1911. Her two sisters, however, became minelayers. In 1911-12 they were converted to lay 97 mines, and in 1915 they operated off the Syrian coast under Capitaine de Vaisseau Causse in the armoured cruiser *Admiral Charner*. The *Casabianca* blew up on one of her own mines in the Gulf of Smyrna on the night of June 4, 1915. The *Cassini* operated with the cruiser squadron of the Armée Navale in 1914, then joined the Otranto Straits patrol. On June 8, 1916, she opened fire on the submarine *U35* which was shelling a British merchantman off Corsica, but on February 28, 1917, she sank after striking a mine laid by *UC35* in the Bonifacio Straits.

Displacement: D'Iberville 925 tonnes (normal) *Length:* 81.9 m (268 ft 8½ in) oa *Beam:* 8.32 m (27 ft 3½ in) max *Draught:* 3.99 m (13 ft 1 in) max *Machinery:* 2-shaft quadruple-expansion, 5000 ihp=21 knots *Protection:* 23 mm (0.9 in) waterline belt; 15 mm (0.59 in) deck *Armament:* 1 100-mm (3.9-in); 3 65-mm (2.56-in) (3×1); 7 47-mm (1.85-in) (7×1); 3 17.7-in (45-cm) torpedo tubes (3×1), later removed *Crew:* Unknown (*Cassini* and *Casabianca* as minelayers) *Displacement:* 960 tonnes (normal) *Length:* 81.1 m (266 ft 1 in) oa *Beam:* 8.32 m (27 ft 3½ in) max *Draught:* 3.5 m (11 ft 5¾ in) max *Machinery and Protection:* As *D'Iberville Armament:* 1 100-mm (3.9-in); 3 65-mm (2.56-in); 97 mines *Crew:* Unknown

Name	launched	builder
D'Iberville	9/1893	Ch de la Loire, Nantes
Cassini	6/1894	Forges et Ch de la Mediterranée
Casabianca	1894	At et Ch de la Gironde, Bordeaux

DICORAP

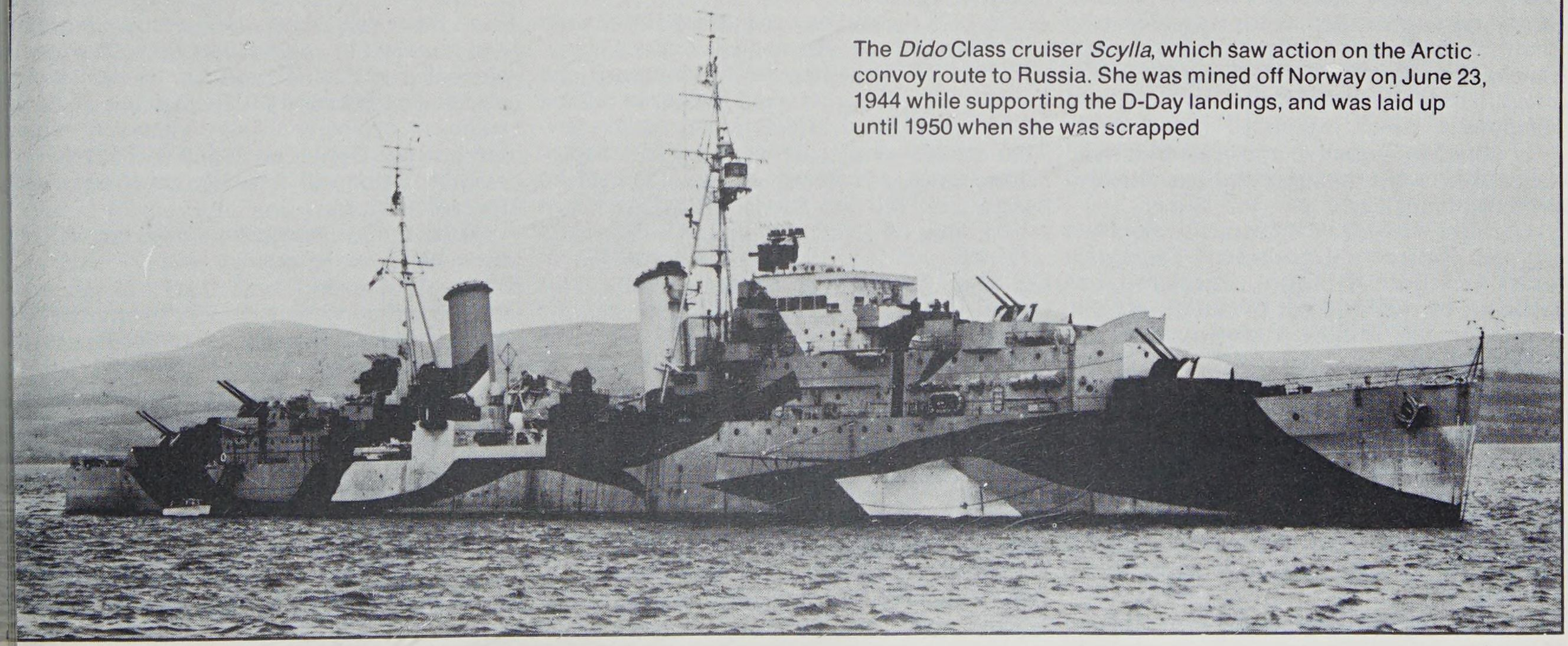
US weapon system. DICORAP stands for Directionally Controlled Rocket Assisted Projectile. It was an experimental development of the late 1960s by the Singer-General Precision company and the US Army Material Command, and was a fin-stabilized cannon-fired projectile with some unusual characteristics.

The shape resembled a mortar bomb, with a bulbous pointed head of 279-mm (11-in) calibre and a long trail boom carrying a set of folding fins. The head unit contained a cold gas-driven gyroscope which was released and spun up as the weapon was fired from a howitzer. Once running, it sensed the position of the weapon and delivered commands to the thrust nozzles of a liquid-fuel rocket motor to steer the weapon in flight. The fins were solely for stabilizing the weapons in the correct flight attitude at launch before the rocket was ignited.

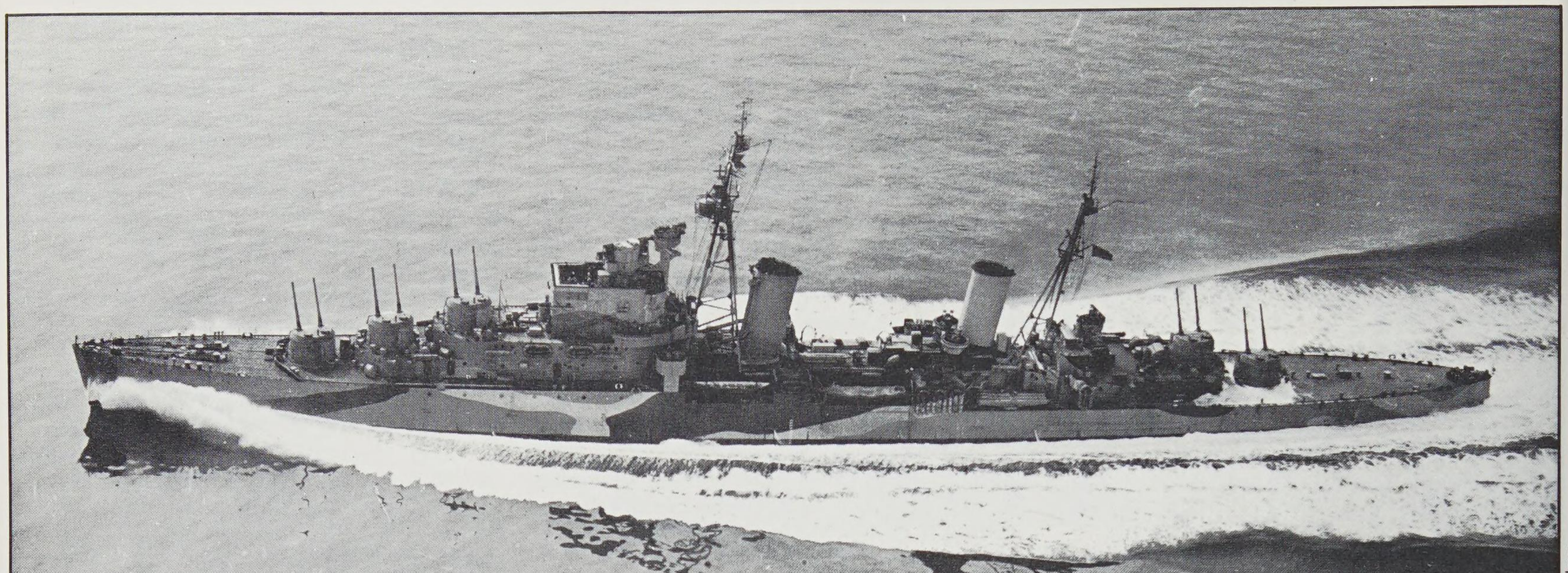
The first successful firings took place in September 1969, but little more was heard of the weapon thereafter. It is believed that it was discarded as a possible weapon system but that the research proved valuable for application to other development programmes.

Dido

British cruiser class. The *Dido* Class were designed primarily as Fleet antiaircraft escorts, for which purpose they were fitted with a uniform armament of ten 5.25-in (133.3-mm) Mk I guns of new design. These were mounted in five twin-dual purpose turrets so that the ships were also capable of engaging surface targets. However, this double requirement complicated both the gun mounting and the fire control gear and they were not as efficient in the antiaircraft role as they would have been with a pure high-angle armament. It was also required that they be 'small cruisers' so that larger numbers could be constructed to help make up for the deficiency of cruisers in the fleet. The hull and machinery were the same as those of the earlier *Arethusa* Class with such modifica-



The *Dido* Class cruiser *Scylla*, which saw action on the Arctic convoy route to Russia. She was mined off Norway on June 23, 1944 while supporting the D-Day landings, and was laid up until 1950 when she was scrapped



Argonaut steaming with her ten 5.25-in (133-mm) guns traversed to starboard in an AA role. She was damaged by air attacks in 1942 and 1943

tions as required by the new armament. In particular, this meant a rearrangement of the magazine spaces and superstructure, and a higher bridge to clear the third 5.25-in (133.3-mm) turret.

A total of 16 *Dido*s were constructed, 13 under the peacetime naval estimates of 1936 to 1939 and three under the Emergency War Programme. The last six of these ships were altered while under construction to incorporate the lessons of the war and were known as the *Modified Dido* Class. They had vertical, instead of raked, masts and funnels and had a lower bridge as Q turret was omitted and replaced by a third 4-barrel pom-pom mounting. The *Dido* Class completed between 1940 and 1942 and the Modified vessels during 1943-44. They proved to be good sea boats but structural weaknesses were revealed during heavy weather in the first units to complete, and all had their hulls strengthened.

Manufacture of the 5.25-in (133.3-mm) gun mounting did not keep pace with the construction of the ships and the *Phoebe* and *Dido* completed without Q turret and the *Bonaventure* without X turret. All three mounted a single 4-in (102-mm) gun in place of the missing weapon which was eventually fitted in the first two only, the *Bonaventure* having been sunk. No 5.25-in (133.3-mm) mountings were available for the *Scylla* and *Charybdis*, which completed with 8 4.5-in (114-mm) (4×2) dual purpose guns instead and neither ship ever received her intended armament.

During 1943-44 Q turret was removed from *Phoebe, Cleopatra, Argonaut* and *Euryalus* in order to reduce topweight. The turret was replaced by a third 2-pdr mounting (1×4) in the latter pair and by a quadruple 40-mm (1.57-in) Bofors mounting in the former pair which also had their two pom-pom mountings replaced by quadruple 40-mm (1.57-in) Bofors. The *Royalist*, in 1943, and the *Scylla* (1944) were refitted to serve as escort carrier squadron flagships and were equipped with the radar, communication equipment and accommodation necessary for this role for which the escort carriers themselves had insufficient space.

The *Dido*s served mainly in the Mediterranean during the war where they saw much front-line service including Malta convoys, the battles for Greece and Crete and the actions in the Gulf of Sirte. In the latter years of the war, the bulk of the class transferred to home waters but some joined the Eastern and Pacific fleets. Of the five ships lost, three were sunk by submarine torpedoes in the Western Mediterranean, the *Bonaventure* by the Italian *Ambra* on March 31, 1941, the *Naiad* by *U 565* on March 11, 1942, and the *Hermione* by *U 205* on June 16, 1942. The *Charybdis* was torpedoed twice and sunk by the German U-Boats *T23* and *T27* during a night action in the English Channel on October 23, 1943.

The only *Modified Dido* to be lost was *Spartan* which was hit and sunk by an HS293 glider bomb off Anzio on January 29, 1944. In addition to the above, the *Phoebe* and *Cleopatra* were extensively damaged by submarine torpedoes and the *Argonaut* by aircraft torpedoes during 1942-43 and all three were under repair in the US for long periods. The *Scylla* was damaged by a mine off Normandy on June 23, 1944, and was laid up until scrapped in 1950.

In 1948 the *Bellona* and *Black Prince* were transferred to the Royal New Zealand Navy. In 1956 the former vessel was returned and replaced by *Royalist* which had been refitted with an enclosed bridge, lattice masts, new fire control and radar gear and a uniform close-range armament of 40-mm (1.57-in) guns. The *Diadem* was sold to Pakistan in 1956 and renamed *Babur*, and the *Black Prince* were also given a uniform 40-mm (1.57-in) armament. The Royal Navy ships were sold for scrap during 1955-59 and the New Zealand vessels in 1962 and 1968. The *Babur* was still in service in 1978.

Dido, Charybdis, Argonaut—built by Cammell Laird
Euralus—built by Chatham dockyard
*Naiad, Cleopatra, Diadem**—built by Hawthorn Leslie
*Phoebe, Bellona**—built by Fairfield
Sirius—built by Portsmouth dockyard
Bonaventure, Scylla, Royalist—built by Scotts
Hermione—built by Stephen
*Black Prince**—built by Harland and Wolff
*Spartan**—built by Vickers Armstrong.
* *Modified Dido* Class

Displacement: 5600 tons (standard), 7000 tons (full load) *Length:* 156 m (512 ft) *Beam:* 15.4 m (50 ft 6 in) *Draught:* 4.3 m (14 ft) *Machinery:* 4-shaft geared steam turbines, 62 000 shp = 32 knots *Protection:* 76 mm (3 in) sides; 50.8 mm (2 in) deck *Armament:* 10 5.25-in (133.3-mm) (5×2); 8 2-pdr pom-poms (2×4); 8 0.5-in (12.7-mm) (2×4); 6 21-in (53-cm) torpedo tubes (2×3) *Crew:* 480

Dinah Allied code-name for Mitsubishi Ki-46 Japanese reconnaissance aircraft See **Ki-46**

Dingbat

British antipersonnel 'scatter' mine. About 76 mm (3 in) in diamater, Dingbat is covered on one side by camouflaged cloth which makes it extremely difficult to see in vegetation. It can be quickly armed and put on the ground without having to prepare a place for it. In these conditions, a large protective field can be sown in a very short time. The small size also makes it difficult to detect by electronic methods. Although small, there is sufficient explosive inside to severely injure any person stepping on it, and vehicles driven over the mine will certainly have pneumatic tyres destroyed.

Details of dimensions, construction, etc have not been released.

DK Soviet machine-gun See **Degtyarev**

Do C, D and T, Dornier

German transport aircraft. These aircraft were three of a large family of civil/military aircraft produced in the late 1920s, and surviving documentation on their design and weaponry is both sparse and conflicting, due to the fact that Germany was officially an 'unarmed' country at that time.

Development began in 1920 with the Do C

III (Komet I). This was a high-wing commercial transport with an open cockpit for the pilot and an enclosed cabin seating four passengers. It had an exceptionally long wingspan of 17 m (55 ft 9¼ in) and could be powered by either a 180-hp BMW III or 185-hp BMW IIIa engine. It was built in small numbers and used by various German airlines with some success. A modified version, the Komet II, utilized the same wing configuration, but with an increased overall length. Powered by a 250-hp BMW IV engine, it made its first flight on October 9, 1922, and was ultimately produced in somewhat larger numbers than the Komet I.

This was followed by the six-passenger Komet III, which first flew on December 7, 1924, with a 360-hp Rolls-Royce Eagle powerplant. This same engine was used in a parasol-wing development, the Do C, produced shortly afterwards as a training aircraft. Some Do Cs were operated by the Fuerza Aérea de Chile as light bombers in about 1930.

The Do D torpedo-bomber, which flew for the first time in July 1926, was a twin-float version of the Do C, with a 600-hp BMW VI engine, which entered limited production for the Yugoslav naval air service in 1927. In 1925, two other versions of the Komet III were evolved: an ambulance model, designated Do T, and a passenger counterpart with a 600-hp BMW VI, the latter receiving the name Merkur (or Do B) and serving with German and Russian airlines.

Production details are impossible to give. It is known that the civil Komet and Merkur series, together with the Do T, were built openly in Germany; the para-military variants most likely emanated from the Dornier factory at Altenrhein in Switzerland.

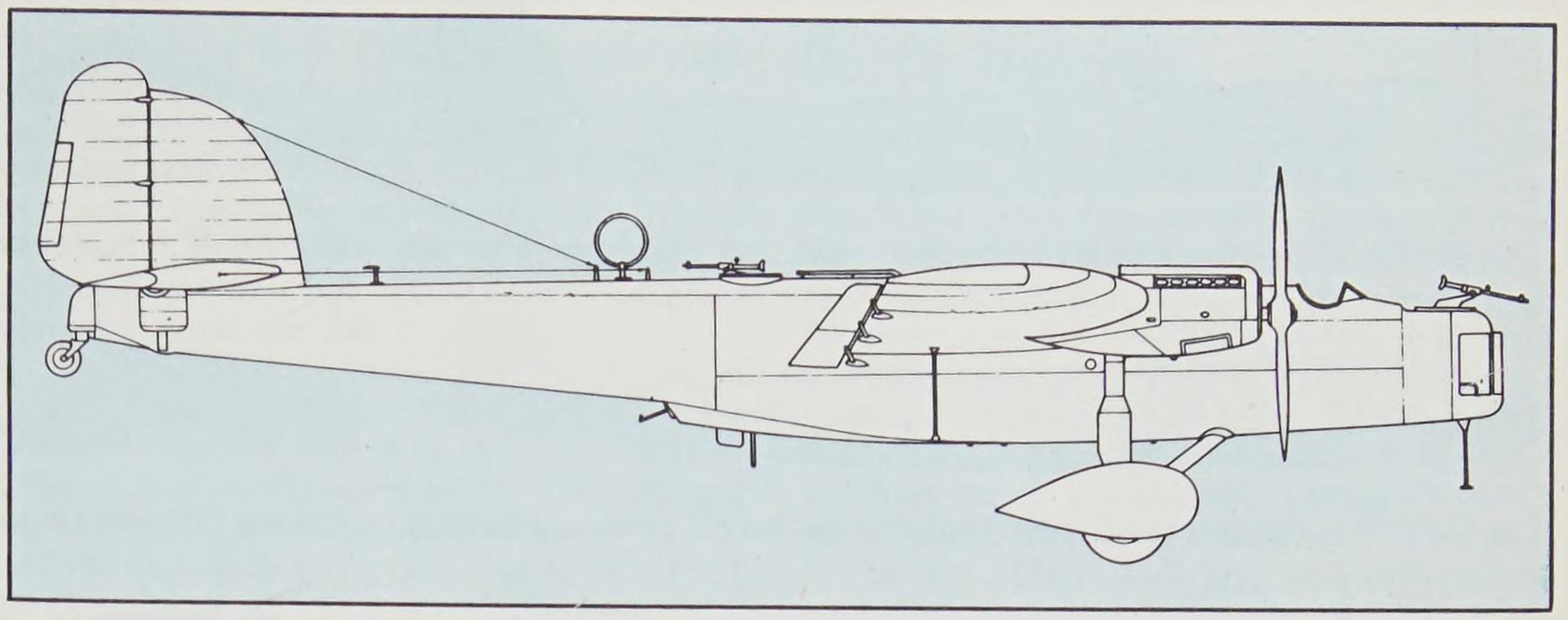
(Do C) *Span:* 19.60 m (64 ft 3¾ in) *Length:* 12.43 m (40 ft 9½ in) *Gross weight:* 3900 kg (8598 lb) *Maximum speed:* 195 km/h (121 mph)

Do 11, 13 and 23, Dornier

German bombers. Prior to the appearance of the Do 17 in the mid-1930s, Dornier had been primarly concerned with the design of seaplanes and flying-boats. The Do 11/13/23, however, originated from the Do F, built at Dornier's Altenrhein factory in Switzerland, and which first flew in May 1932, powered by two 550-hp Siemens-built Bristol Jupiter radials and having a retractable main landing gear.

In 1933, well before the official establishment of the Luftwaffe, an official order was placed for a production version of the Do F with two 650-hp Siemens Sh 22B-2 nine-cylinder radials, driving three-blade wooden propellers. They were delivered from late 1933 as Do 11Cs, ostensibly as freighters to be used by the German State railway. Although they were so used, gun installations, bomb racks and other military items were delivered separately and secretly. Thus they could be converted quickly into bombers and were openly in service as such in early 1934 with the Befehlskampfgeschwader (auxiliary bomber wing) of the Luftwaffe.

The Do 11C was a twin-engined, high-wing monoplane, with an all-metal fuselage and a glazed observation section in the nose. The crew consisted of a pilot, wireless operator and two gunners, the latter sharing the three single 7.9-mm (0.311-in) MG 15 machine-guns, one each in dorsal and ventral positions and one on a ring mounting forward of the front cockpit.



The Dornier Do 23G, the first medium bomber to serve with the newly-formed Luftwaffe

The Do 11C was a contemporary of the Ju 52/3m in the initial formation of Luftwaffe bomber squadrons, but was less satisfactory, having poor flying characteristics. This quickly led to the development of the Do 11D with modified, shorter-span wings, and the Do 11Cs in service were also converted to this standard. This was further developed into the Do 13, by fitting non-retractable landing gear and doing away with the glazed nose and the small auxiliary horizontal stabilizers fitted under the Do 11's tailplane.

The Do 13 was first flown on February 13, 1933, with the same powerplant as its predecessor. Substitution of Junkers-type 'double-wing' trailing-edge flaps, similar to those of the Ju 52/3m, gave it improved landing characteristics, and when the Sh 22 engines were replaced by a pair of 750-hp 12-cylinder liquid-cooled BMW VIU's, driving four-blade propellers, the bomber was redesignated Do 13C. After further attempts to overcome deficiencies in the wing structure, it was ordered into series production by the Luftwaffe as the Do 23.

Original orders had been for 372 Do 11s, but only about 150 were delivered as such. A further 222 were then reordered as Do 13Cs, but after about a dozen of these had been delivered, they were found to be even less satisfactory than the Do 11C and D, and production was halted while the airframe was restressed and modified. Production was resumed after the first flight, on September 1, 1934, of the Do 13e prototype for the production Do 23F, with BMW VId powerplant. This was quickly followed by the Do 23G, which became the principal service version and returned to the BMW VIU engine. All unfulfilled orders for the Do 11 and 13 were transferred to the Do 23 contract, deliveries of which began in spring 1935, and had totalled just over 200 when production ended in late 1935.

The Do 23 was not destined for a long service life. From mid-1936 it began to be replaced by the Do 17, Ju 88 and He 111. It was then relegated to second-line duties, including training. Although obsolete by the outbreak of the Second World War, a small number did continue in service with Minensuchstaffeln during the early war years, equipped with a large degaussing ring for clearing British mines from around the German coast. Some earlier Do 11Ds were transferred by Germany to the Bulgarian air force but these too were only used during the early part of the war.

(Do 11D) *Span:* 26.30 m (86 ft 3½ in) *Length:* 18.80 m (61 ft 8¼ in) *Gross weight:* 8200. kg (18 078 lb) *Maximum speed:* 260 km/h (161 mph)

Do 17 and Do 215, Dornier

German medium bomber and reconnaissance aircraft. Designed originally as a six-passenger, high-speed mailplane for Deutsche Luft Hansa's European route network, the exceptionally clean and slender first prototypes of the Do 17, the Do 17 V1, flew for the first time in the autumn of 1934, powered by a pair of 660-hp BMW VI 12-cylinder liquid-cooled V-type engines.

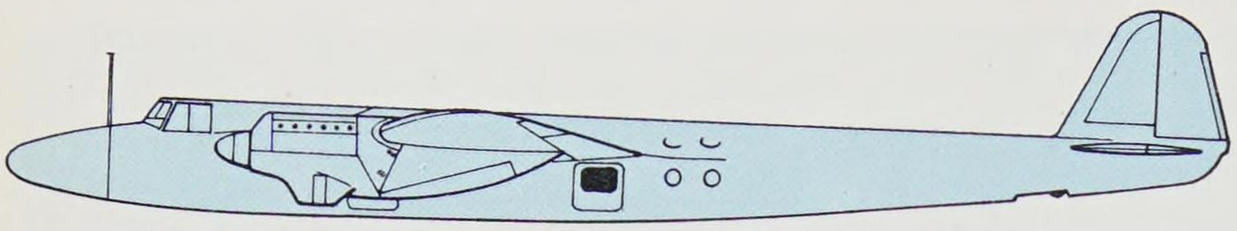
Three prototypes were completed for DLH, each of them having a single fin and rudder; but their remarkable slimness, while contributing to an outstanding performance, was also their commercial undoing, the very narrow fuselage making it extremely difficult for passengers to reach their seats. Following its rejection by DLH, the Do 17 design languished for a time, until the RLM (Reichsluftfahrtministerium, or German aviation ministry), seeking a new medium bomber for the Luftwaffe, was persuaded to evaluate the Dornier aircraft for this role.

The RLM ordered further prototypes, beginning with the Do 17 V4 which flew in the late summer of 1935. These were generally similar to the first three prototypes, except for having twin fins and rudders (to make the aircraft a more stable bombing platform) and a decrease of 0.55 m (1 ft 9¾ in) in overall length. They carried a crew of three, and had an all-metal fuselage, metal- and fabric-covered wings, and fully-retractable mainwheels and tailwheel. All were broadly similar, except for the installation of 775-hp Hispano-Suiza 12 Ybrs liquid-cooled V-type engines in the Do 17 V5 and a defensive armament of a single hand-operated 7.9-mm (0.311-in) MG 15 machine-gun in the cockpit of the Do 17 V7.

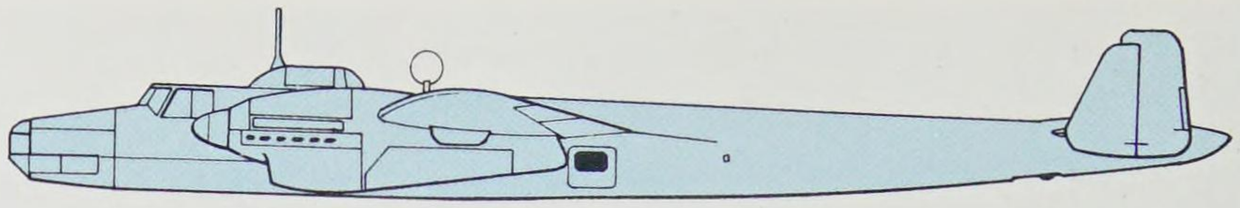
The first version to go into production, towards the end of 1936, was the Do 17E-1 bomber, based on the Do 17 V9, which had a further reduction of 0.90 m (2 ft 11½ in) in the length of the nose. The Do 17E-1, powered by two 750-hp BMW VI 7.3 engines, carried a short-range internal bombload of 750 kg (1653 lb) and had a defensive armament of two MG 15 machine-guns, one above the fuselage and one below.

In parallel production was the Do 17F-1, a

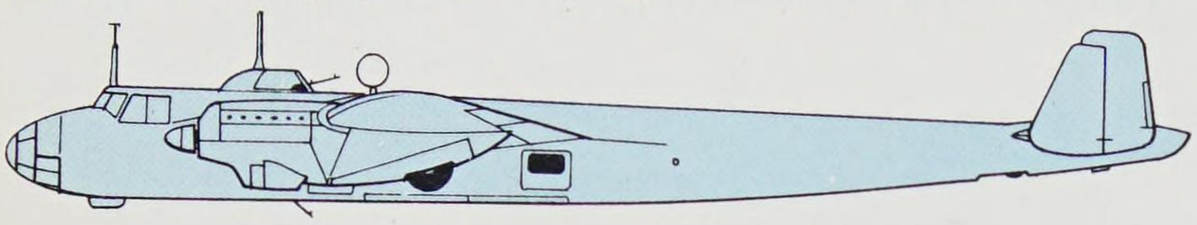
Do 17 and Do 215



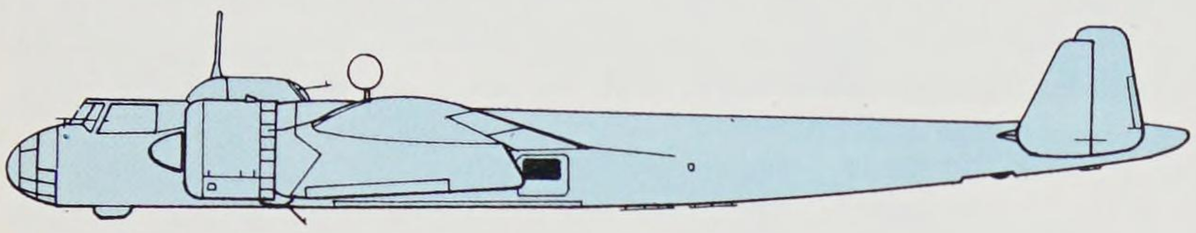
The Do 17 VI 'Flying Pencil' high-speed mail and passenger aircraft



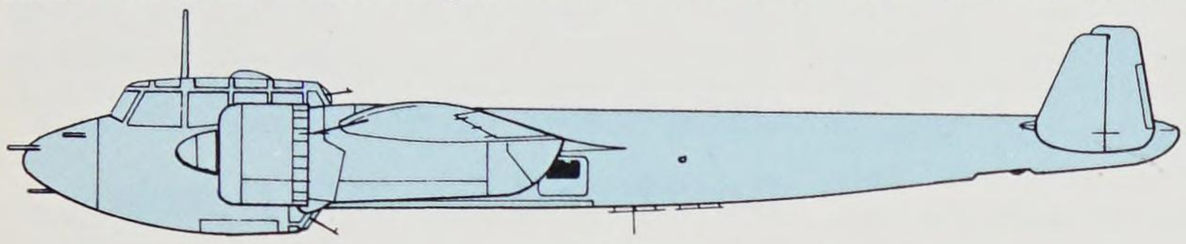
The Do 17 V8, entered for the Military Aircraft Competition in 1937



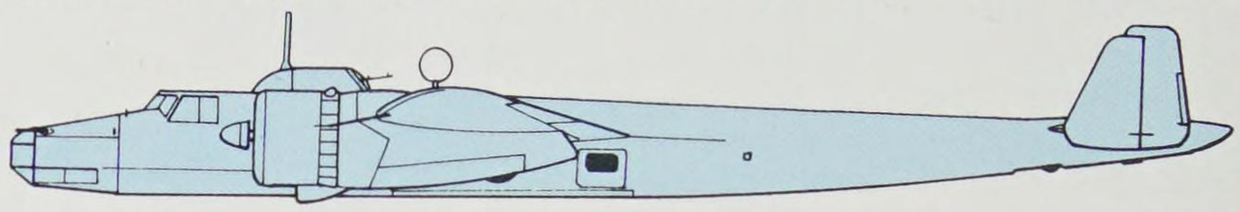
The Do 17E-1, the first production model of the Do 17, produced in 1937



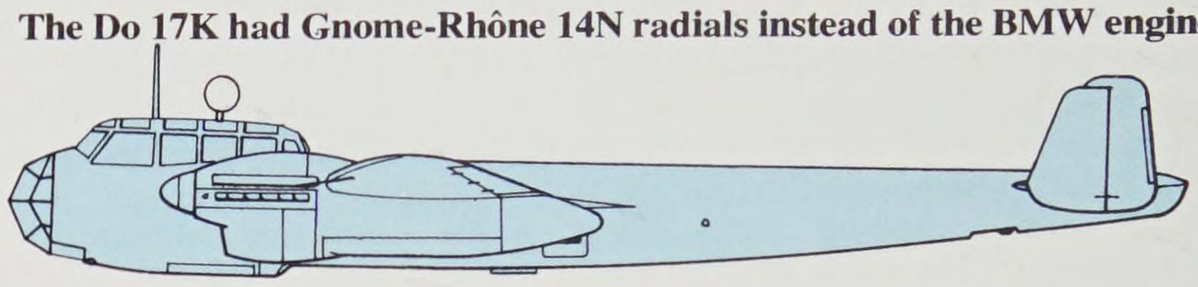
The twin Bramo 323A engined Do 17 M-1 entered production in 1938



The Do 17 Z-10 had four 20-mm cannon and four MG 17s in the nose



The Do 17K had Gnome-Rhône 14N radials instead of the BMW engines



The Do 17 S had a deeper forward fuselage and glazed nose

The Dornier Do 17 began life as a fast mailplane with the Deutsche Lufthansa where its slim lines earned it the nickname 'flying pencil'. Successive alterations changed the profile as gun turrets were added, engines improved and bombloads increased. When eventually it became a night fighter the glazed nose was faired over and fitted with radar and machine-guns and cannon. It served effectively as part of Germany's night defences until replaced by more specialized types

photographic reconnaissance counterpart to the E-1 with two cameras and an extra fuel tank installed in the bomb bay. Both versions were in squadron service with Luftwaffe units by the summer of 1937, the Do 17E-1 initially equipping the I. Gruppen of KG 153 and KG 155 while the F-1 went to the long-range reconnaissance group Fernaufklärungsgruppe 122. During 1937-38 the Do 17E and F were included among the types of Luftwaffe aircraft selected to equip units of the Condor Legion sent by Germany to fight on the Nationalist side in the Spanish Civil War. Here their performance made them virtually immune from interception by their opponents' fighters.

In July 1937, at about the time these first production models were reaching their first squadrons, an international military aircraft competition was staged at Dübendorf, near Zürich in Switzerland. One of the competitors was the French Dewoitine D 510, generally considered at that time to be the best single-seat fighter in service anywhere in Europe. It is not difficult to imagine the reaction that followed when this fast and manoeuvrable little fighter was totally outclassed by an example of the Do 17, a twin-engined bomber—even though this was not revealed at the time. The Do 17 concerned was a specially stripped-down prototype, the Do 17 V8, fitted with DB 600A engines specially boosted to give 1000 hp each.

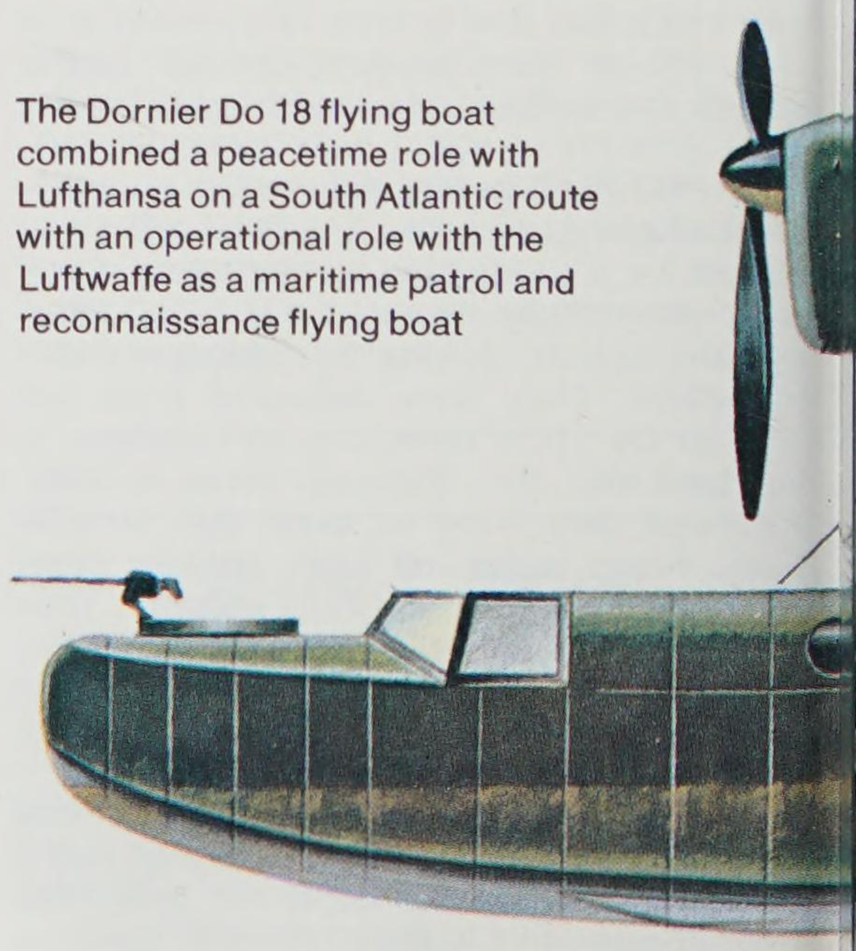
The Do 17 V8's performance had many side-effects, not least on fighter design thinking in countries both inside and outside Europe. A more direct result was an expression of interest in the Do 17 itself from the Yugoslav government, which eventually placed an order for 20 of the German bombers. These export examples were designated Do 17K, and at the request of the customers were powered by Yugoslav-built 980-hp French Gnome-Rhône 14 N radial engines. The 'pure' bombers were designated Do 17Kb-1; reconnaissance models were designated Do 17Ka-2 and Ka-3, the latter doubling also in the bombing and attack roles.

In addition to those supplied from German production, manufacture of the Do 17K was also undertaken under licence, in 1939-40, by the Drzavna Fabrika Aviona (state aircraft factory) at Kraljevo, near Belgrade. The additional available power gave the Do 17K a useful increase in both speed and range, notwithstanding an improved internal bomb-load (in the Kb-1) of 1000 kg (2205 lb) and an armament increased to three 0.312-in (7.92-mm) FN-Browning machine-guns and one 20-mm (0.79-in) Hispano cannon. Seventy Do 17Ks were still in service with the Yugoslav air force when the country was invaded by Germany in early April 1941. Later that month two of them escaped to Greece with a consignment of gold bullion. Losses during the fighting in Yugoslavia were fairly heavy, but those Do 17Ks that survived were passed on in early 1942, after the occupation, to the newly-created Croatian air force.

The improvements in weapon capacity and performance exhibited by the Do 17K had, in fact, been evolved for two generally similar versions for the Luftwaffe, the Do 17M bomber and Do 17P reconnaissance-bomber, the increased power being derived respectively from a pair of 900-hp supercharged Bramo 323A-1 or 865-hp BMW 132M radial engines. In 1938 these began gradually to replace the Do 17Es and Do 17Fs in service, and by September 1938 combined production of the Do 17E, F, M and P series totalled 580.

Three experimental models to be evolved during 1937-38 were the Do 17L, Do 17R and Do 17S. The Do 17L (two prototypes only) was a four-seat pathfinder version with 900-hp Bramo 323A-1 engines. The two Do 17R prototypes were testbeds, one powered by 950-hp Daimler-Benz DB 600G engines and the other by 1100-hp DB 601As. The Do 17S (three built, first flight early 1938) was a high-speed reconnaissance version with DB 600G engines and a crew of four. None of these went into production, but between them the R and S series led to the Do 17U, of which 15 were produced in 1938 and distributed among nine Kampfgruppen (bomber groups) for pathfinder duties. The Do 17U carried a crew of five and was powered by 950-hp DB 600A engines.

The final version in the Do 17 production series, and the one produced in the greatest quantity, was the Do 17Z. A progressive development of the Do 17S/Do 17U, it appeared in late 1938 and broke away from the Do 17's earlier 'Flying Pencil' image by adopting as standard the deeper, more angular and more extensively glazed nose section first seen on the Do 17S. This permitted a heavier defensive armament (which the Do 17 now needed) of up to six MG 15 guns, five of them aimed manually. The Do 17Z series carried a crew of four or five, and were powered at first by Bramo 323A-1 and (from the Z-2) by 1000-hp Bramo 323P series engines. Approximately 525 examples of the Do 17Z were built, of which the Do 17Z-1 (delivered from January 1939) and the Do



The Dornier Do 18 flying boat combined a peacetime role with Lufthansa on a South Atlantic route with an operational role with the Luftwaffe as a maritime patrol and reconnaissance flying boat

17Z-2 (the most numerous sub-type) were bombers, the Do 17Z-3 (22 built) a reconnaissance model, the Do 17Z-4 a dual-control training version of the Z-2, and the Do 17Z-5 a version of the Z-2 for rescue duties.

Luftwaffe strength returns showed a total of 493 Do 17s on charge on December 2, 1939. Of these, 352 were Do 17Zs (mostly Z-2s), 12 were Do 17Fs, 41 were Do 17Ms, and 83 were Do 17Ps. The P and Z models were thus the principal versions encountered during the early attacks on Poland, France, the Low Countries and Britain in 1939-40. They performed reliably and effectively and, despite a fairly high rate of attrition, were popular with their crews. Dornier 17 production ended in July 1940 after approximately 1200 of all models had been built. Only one Geschwader (wing), KG2, used the 17Z for more than a year after the invasion of the Soviet Union.

When it became necessary to find improvized night fighters to counter RAF raids on German-held targets, a small number of Do 17Zs were converted to this role. After trials in 1939 with a Do 17Z-6 Kauz I (screech-owl) prototype, nine more Z-3s were converted in 1940 to three-seat Do 17Z-10 Kauz II night fighters, with a battery of two 20-mm (0.79-in) MF FF cannon and four 7.9 mm (0.312-in) MG 17 machine-guns in a 'solid' nose. Operating with *Nachtjagdgeschwader* 1 in Holland, the Do 17Z-10 scored its first 'kill' on the night of October 18/19, 1940.

In 1938, in the hope of attracting further foreign orders for the bomber, Dornier took two of the pre-production Do 17Z-0s and used them as export demonstration aircraft under the new RLM type number Do 215. Redesignated Do 215 V1 (with Bramo 323 engines) and Do 215 V2 (with 980-hp Gnome-Rhône 14 N radials), the latter was demonstrated to Yugoslavia, but without securing any orders. The only order forthcoming was from Sweden, which was shown the Do 215 V3, another former Do 17Z-0 refitted with 1075-hp DB 601A inverted-V engines. Eighteen of these were ordered for the Swedish air force in mid-1939 as Do 215A-1s, but were not completed before the war.

The first of the batch was flown in December 1939, and all were taken over by the Luftwaffe, with minor modifications, as Do 215B-0s or B-1s. Delivered in early 1940, they were followed into production by two generally similar Do 215B-3s for the Soviet Union (the B-2 was not built); and then by the principal Luftwaffe model, the Do 215B-4 (similar to the B-1, and also with 1100-hp DB 601Aa engines, but fitted with different cameras); and the Do 215B-5.

This final Do 215B version, some 20 of which were converted on the line from Do 215B-4s, was produced in the latter half of 1940 as a night fighter/intruder aircraft, and had a 'solid' nose similar to that of the Do 17Z-10 in which were installed four MG 17 machine-guns and two 20-mm (0.79-in) MG FF cannon. The Do 215B-5 entered service with *Nachtjagdgeschwader* 1 in Holland during late 1940, and in July 1941 was the first operational Luftwaffe aircraft to carry the early Telefunken FuG 202 Lichtenstein BC airborne interception radar. Oberleutnant Ludwig Becker of NJG 1, later to become one of the Luftwaffe's leading night fighter pilots, made the first 'kill' using this equipment on August 9, 1941.

In all, 101 Do 215Bs were built before production ended in January 1941. By this time mainstream development of the Do 17/215 bomber concept was well under way in the more advanced form of the Dornier Do 217, the first examples of which had entered service towards the end of the previous year. After 1942, virtually no Do 215s remained in service with first-line units, those which survived being reallocated mostly to test and development work. The Do 17, however, following its replacement by the Do 217 in 1942, found a new career as a glider tug and continued in the role to the end of the war.

(Do 17E-1) *Span:* 18 m (59 ft ¾ in) *Length:* 16.25 m (53 ft 3¾ in) *Gross weight:* 7040 kg (15 520 lb) *Maximum speed:* 355 km/h (220 mph)

(Do 17M-1) *Span:* 18 m (59 ft ¾ in) *Length:* 16.10 m (52 ft 9¾ in) *Gross weight:* 8000 kg (17 637 lb) *Maximum speed:* 410 km/h (255 mph)

(Do 17Z-2) *Span:* 18 m (59 ft ¾ in) *Length:* 15.79 m (51 ft 9¾ in) *Gross weight:* 8590 kg (18 938 lb) *Maximum speed:* 360 km/h (224 mph)

(Do 215B-4) *Span:* 18 m (59 ft ¾ in) *Length:* 15.79 m (51 ft 9¾ in) *Gross weight:* 8800 kg (19 401 lb) *Maximum speed:* 475 km/h (295 mph)

Do 18, Dornier

German maritime patrol and reconnaissance flying boat. Evolved as a civil and military successor to the Dornier Wal, the first of five Do 18 prototypes (registered D-AHIS) flew on March 15, 1935, powered by two 540-hp Junkers Jumo 5 engines. These five prototypes were delivered to Deutsche Lufthansa. A total of about 160 was eventually built during 1936-40, the major Luftwaffe versions being the Do 18D (about 75 built) and Do 18G and H (71 built).

The Do 18D-1, D-2 and D-3 differed in equipment only and were delivered from mid-1936. By the autumn of 1939 they equipped single Staffeln of five Küstenfliegergruppen (coastal aviation groups). Powered by 600-hp Jumo 205C engines, they were only lightly armed with single bow and dorsal 7.9-mm (0.311-in) MG 15 machine-guns, and could carry two 50-kg (110-lb) bombs beneath the starboard wing. Do 18Ds took part in many early wartime campaigns, among them Poland, Norway and the Battle of Britain.

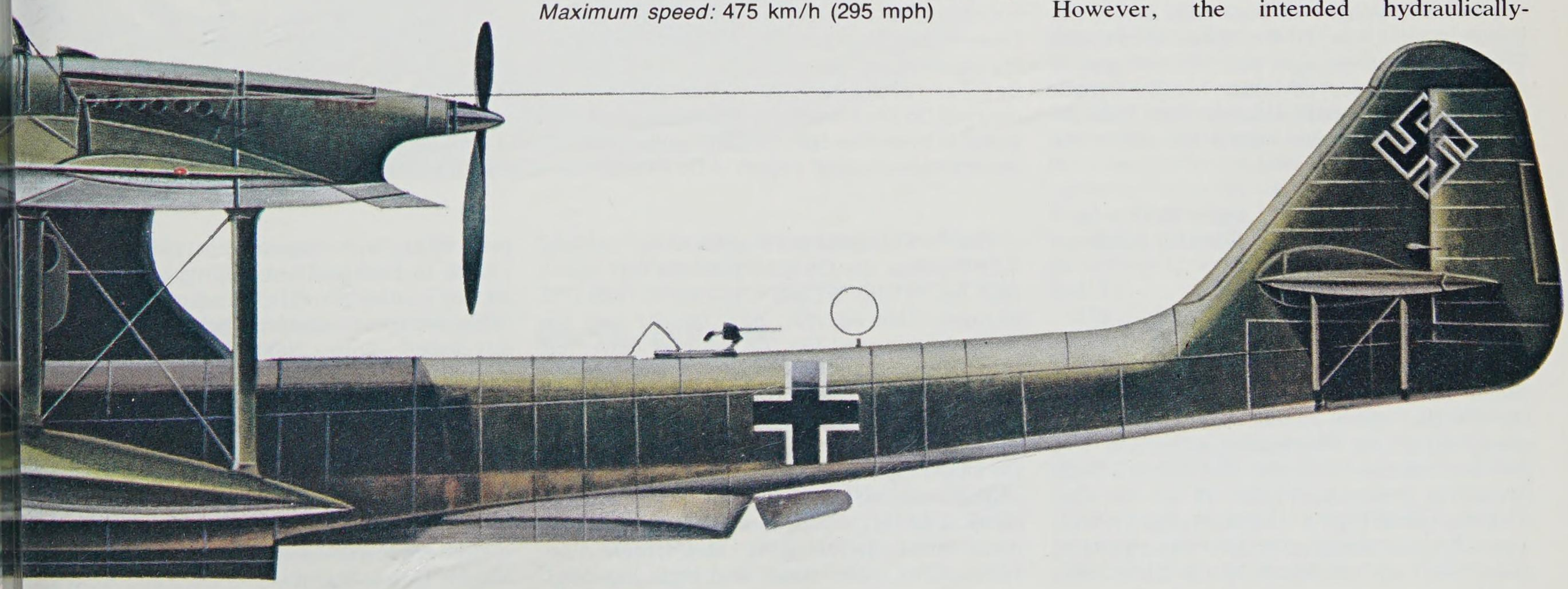
The Do 18G-1, which entered service from mid-1939, had 880-hp Jumo 205D engines, a 13-mm (0.51-in) MG 131 in the bow, a 20-mm (0.79-in) MG 151 in a power-operated dorsal turret, and provision for rocket-assisted take-off. The Do 18H-1 was a six-seat unarmed trainer version.

Both the Do 18D and the Do 18G had been withdrawn from first-line service by autumn 1941, but some G-1s were converted to Do 18N-1s for air/sea rescue duties.

(Do 18G-1) *Span:* 23.70 m (77 ft 9 in) *Length:* 19.25 m (63 ft 2 in) *Gross weight:* 10 759 kg (23 719 lb) *Maximum speed:* 267 km/h (166 mph)

Do 19, Dornier

German heavy bomber project. As early as 1934 the Luftwaffe began to think about a long-range heavy bomber, and in 1935 a specification for the 'Ural Bomber' was issued to Junkers and Dornier. The prototype Do 19 V1 flew in October 1936. With a rectangular-section monocoque fuselage, broad low-set wings and twin vertical tail surfaces, the V1 was powered by four 600-hp Bramo 322H nine-cylinder aircooled radials, and was intended to carry a crew of nine. However, the intended hydraulically-



operated two-man dorsal and ventral turrets, combined with the overweight aircraft, would have left the bomber severely underpowered. Using lighter turrets and Fafnir 323A-1 engines, a revised design showed an estimated range of 2000 km (1240 miles) and a top speed of 370 km/h (230 mph), but by this stage there were doubts about the usefulness of the 'Ural Bomber' and the ability of the aircraft industry to produce it without reducing the supply of other warplanes. Work on the project was dropped and resources switched to the smaller Heinkel He 177.

(Do 19 V1) *Span:* 35 m (114 ft 10 in) *Length:* 25.45 m (83 ft 6 in) *Gross weight:* 18 500 kg (40 785 lb) *Maximum speed:* 315 km/h (196 mph)

Do 22, Dornier

German torpedo-bomber and reconnaissance aircraft. Developed in 1934 at the Altenrhein factory, the Do 22 all-metal, fabric-covered parasol monoplane first appeared as a twin-float seaplane. Orders were not received from the Luftwaffe, but some were produced at Friedrichshafen for export to Latvia (Do 22 Kl), Greece (12 Do 22Kg) and Yugoslavia (12 Do 22Kj).

The first production floatplane flew on July 15, 1938, followed by the Do 22L (a landplane model registered D-0XWD) on March 10, 1939. Both versions were powered by a 775-hp Hispano-Suiza 12 Ybrs 12-cylinder liquid-cooled engine, driving a three-blade propeller through which fired a 7.62-mm (0.30-in) or a 7.9-mm (0.311-in) gun. One or two more guns of similar calibre were ring-mounted in the rear cockpit, and another fired rearward through the fuselage floor. There were racks on the underside of the fuselage for a single 800-kg (1764-lb) torpedo or four 50-kg (110-lb) bombs.

The Do 22 fought on *both* sides during the Second World War. Of the 12 delivered to the Yugoslavian navy, eight escaped to Egypt in April 1941 and served under No 230 Squadron RAF in the Mediterranean; and four Do 22Kl from the Latvian order were sold to the Finnish air force in 1941.

Span: 16.20 m (53 ft 1¾ in) *Length:* 13.15 m (43 ft 1¾ in) *Gross weight:* 4000 kg (8818 lb) *Maximum speed:* 350 km/h (217 mph)

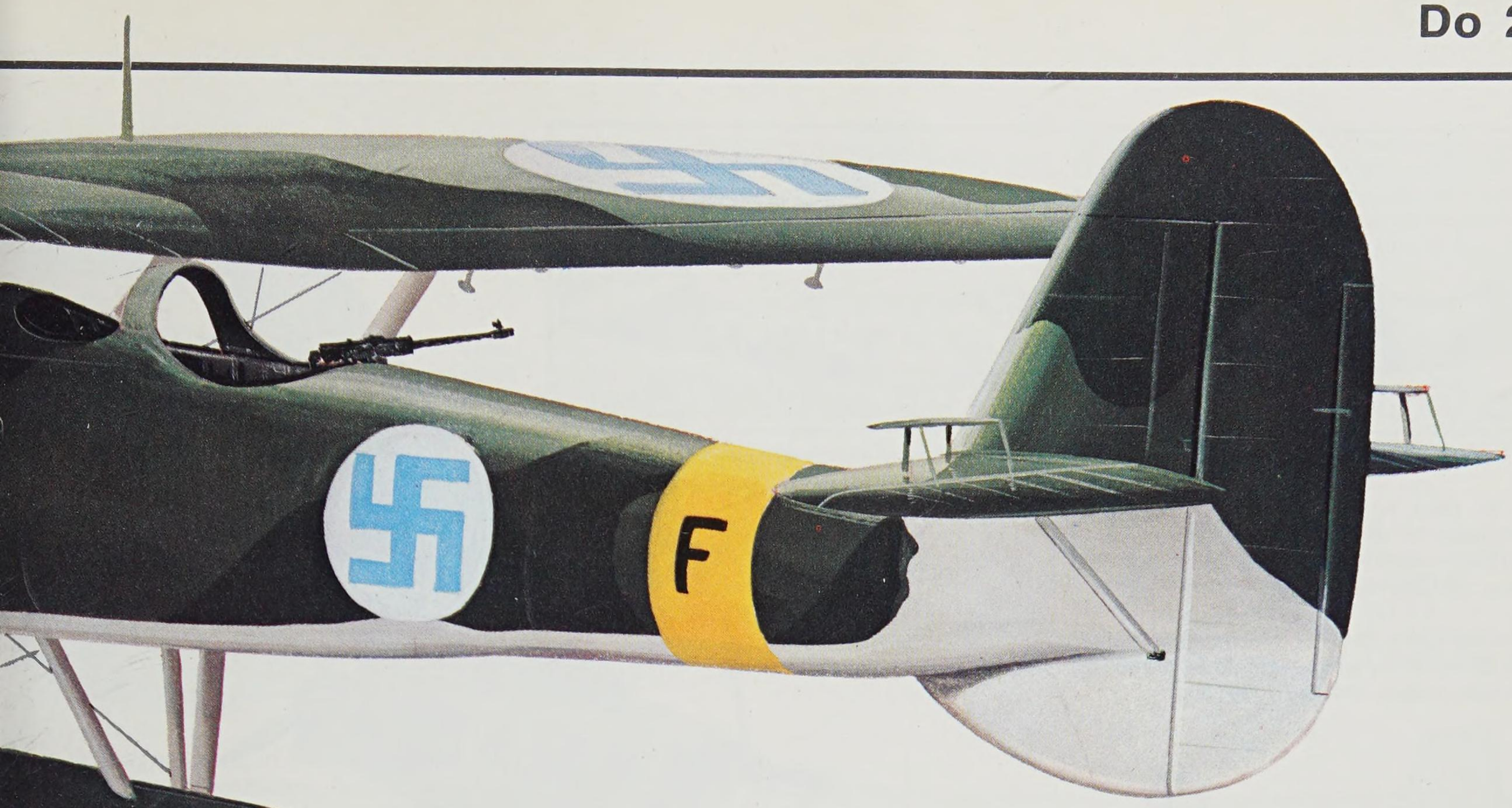
Do 24, Dornier

German general-purpose flying boat. Broadly similar in design and layout to the Do 18, the Do 24 had three radial engines mounted separately on the wing leading-edge, and twin fins and rudders. Of the 294 Do 24s built (including prototypes) only 37 saw service with the Dutch East Indies navy, for whom it was originally designed in 1935. By contrast, some 222 were employed by the Luftwaffe.

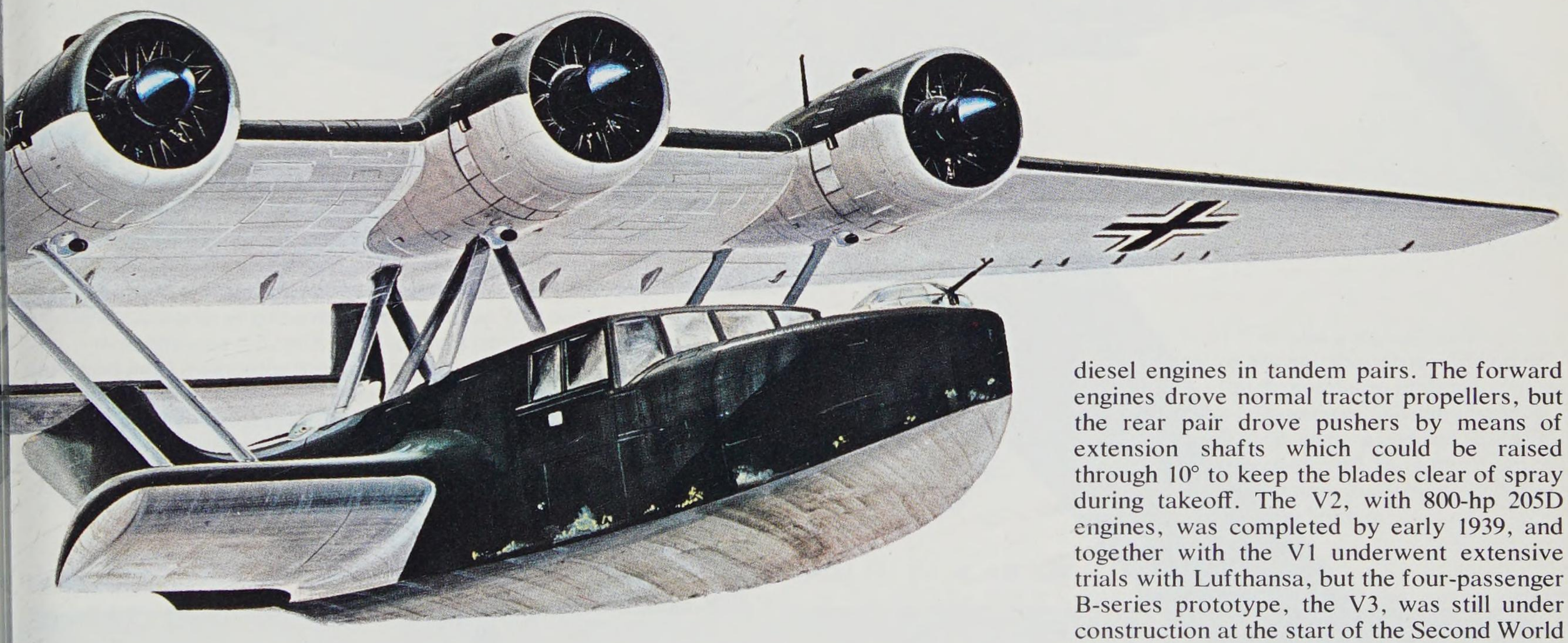
The Dornier Do 24 flying-boat was not only used by Seenotstaffeln (the German air/sea rescue service), but also by the Dutch forces in the Far East. When Do 24N-1 flying boats were entering service with the Germans, Dutch Do 24Ks or 'X-boats' were in action against Japanese troopships. German-crewed Do 24s operated over the English Channel and Western Approaches and evacuated troops from the Crimea, Crete and the Dodecanese. The standard load was 24 men each with 30 kg (66 lb) of equipment. By the end of October 1944 they had lifted 3000 troops from the Aegean islands. The crews of Do 24s took great risks to rescue shot down pilots; on one occasion a Do 24T based at Brest flew 560 km (350 miles) out into the Atlantic to pick up the crew of a shot down meteorological aircraft. A Do 24 even flew to the Scilly Islands to pick up a pilot

The first of three prototypes to fly, on July 3, 1937, was the Do 24 V3 (D-AYWI), powered by 875-hp Wright Cyclone R-1820-F52 engines. This aircraft, plus the V4 and ten similarly-powered Do 24K-1s were delivered to the Dutch navy, and apart from the Jumo 205C-engined V1 and V2 were the only German-built examples.

Production continued with 28 Dutch-built Do 24K-2s, powered by 1000-hp R-1820-G102 engines, and carrying revised armament and up to 12 50-kg (110-lb) bombs. Twenty-five of these were delivered to the Dutch East Indies. The other three, and eight partially-built K-2s, were captured in 1940 and completed to Luftwaffe standards as Do 24N-1 air/sea rescue aircraft. From this the major ASR/transport version, the Do 24T-1, was developed with 1000-hp Bramo 323R-2 engines. Armament consisted of a 20-mm (0.79-in) Hispano cannon in a dorsal turret and single 7.9-mm (0.311-in) machine-guns in the bow and stern positions. One hundred and eighty of these were built (110 in Holland and 70 by CAMS in France). Forty-nine Dutch-built Do 24T-2s were sold to Spain, and in 1944 Spain also purchased 12 generally similar Dutch-built Do 24T-3s. Only 48 of the



A Dornier Do 22Kl, one of four supplied to Finland in 1941. They were equipped with either floats or skis and used for coastal reconnaissance and antisubmarine patrols. Prior to the war the Do 22 was ordered by Greece, Latvia and Yugoslavia, though the Latvian order went to Finland after the Soviet Union invaded Latvia. During the war the Greek aircraft were soon lost in action, but 12 Yugoslavian aircraft escaped to Egypt where they equipped No 2 (Yugoslav) Squadron which operated from Aboukir under the control of No 230 Squadron. The unit was disbanded in April 1942 after one aircraft had been cannibalized for spare parts



French-built T-1s reached the Luftwaffe, the remainder being 'liberated' and used as transports by Flottille 9F Tr of the French Aéronavale starting in December 1944 with the first two.

The Dutch East Indies Dorniers operated for some time against Japanese shipping in the southwest Pacific; those of the Luftwaffe saw action in the Baltic, English Channel, Mediterranean and the Black Sea.

(Do 24T-1) *Span:* 27 m (88 ft 7 in) *Length:* 22.05 m (72 ft 4 in) *Gross weight:* 16 200 kg (35 715 lb) *Maximum speed:* 332 km/h (206 mph)

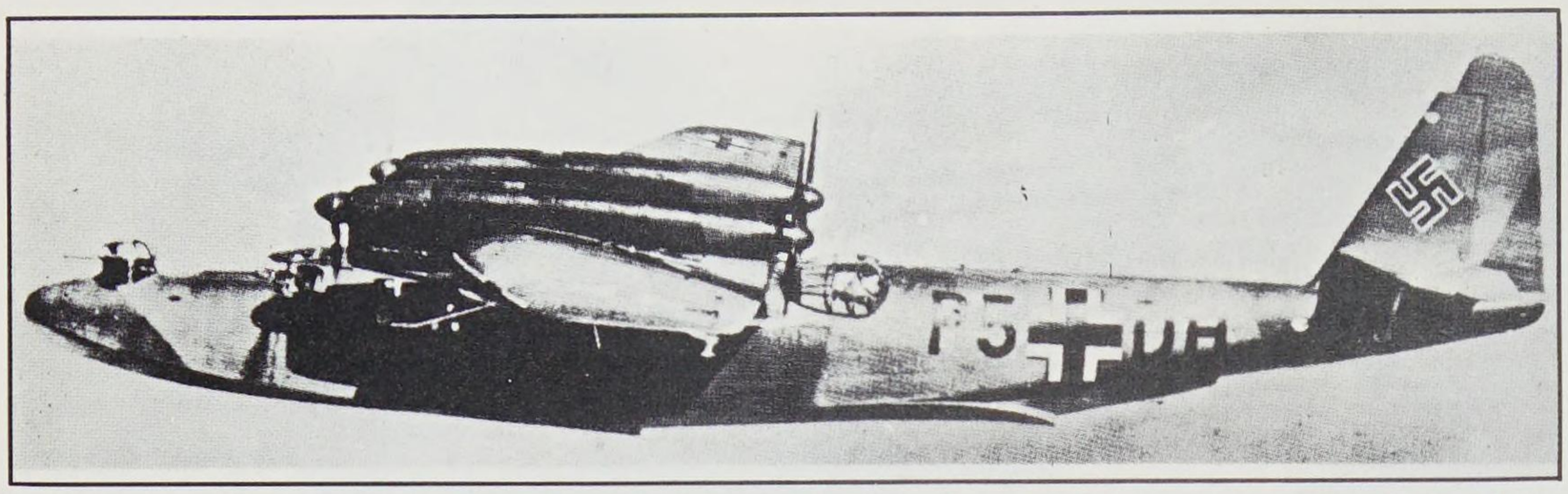
Do 215, Dornier Export model of Dornier Do 17 German medium bomber See **Do 17**

Do 26, Dornier

German transport and maritime reconnaissance flying boat. The Do 26 was originally produced for Lufthansa as a mailplane capable of flying non-stop between Lisbon and New York. A complete break with previous Dornier flying boat designs, the Do 26 V1, which flew for the first time on May 21, 1938, used a cantilever wing housing retractable stabilizing floats and four 600-hp Jumo 205C diesel engines in tandem pairs. The forward engines drove normal tractor propellers, but the rear pair drove pushers by means of extension shafts which could be raised through 10° to keep the blades clear of spray during takeoff. The V2, with 800-hp 205D engines, was completed by early 1939, and together with the V1 underwent extensive trials with Lufthansa, but the four-passenger B-series prototype, the V3, was still under construction at the start of the Second World War in September 1939 and was taken over by the Luftwaffe along with three eight-passenger C-series prototypes, the V4, V5 and V6.

The Luftwaffe ordered the last four to be adapted as Do 26D dual-role long-range maritime reconnaissance aircraft, with a 20-mm (0.79-in) MG 151 cannon in a powered bow turret, two glazed blisters amidships each mounting a single MG 15 machine-gun, and a third MG 15 below the rear hull. Along with the V2 prototype, the four converted machines were used during the invasion of Norway on supply and communications operations in and out of the narrow fjords. On

Do 26



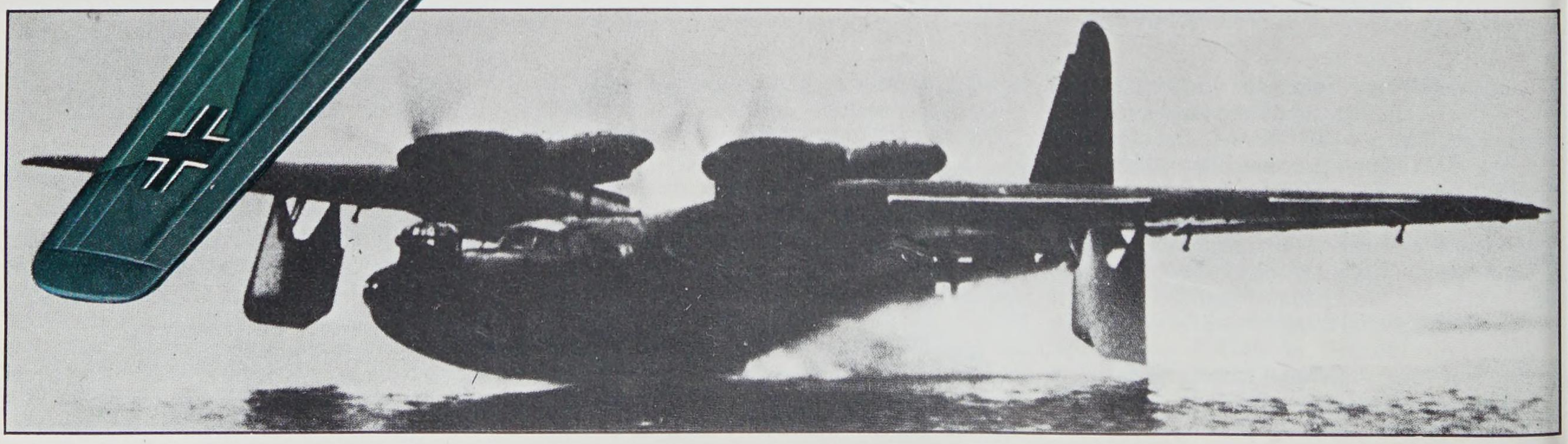
The Dornier Do 26 V6, the last of the prototypes developed as an eight-passenger fast flying boat

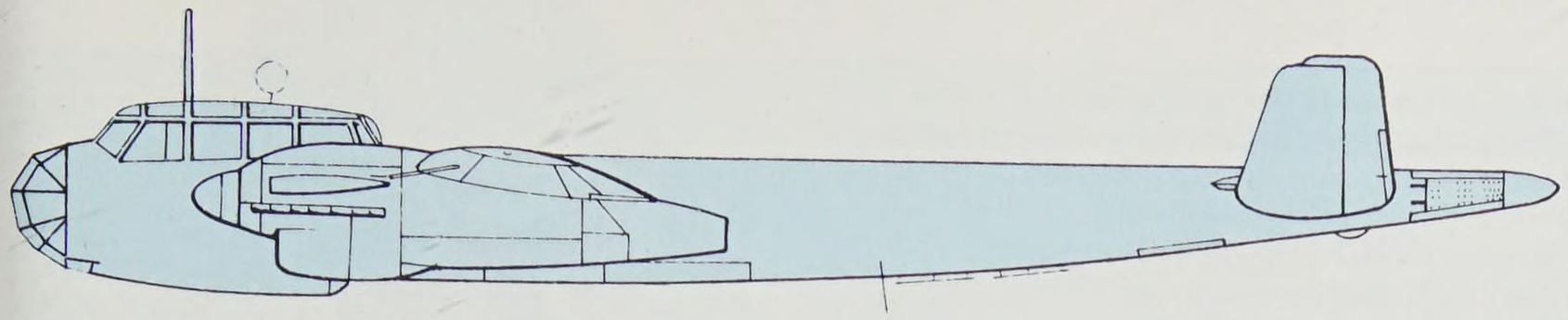
May 28, 1940, two Do 26s were shot down by Hurricanes of 46 Squadron, RAF, in Rombaksfjord while attempting to land. No further Do 26s were built.

(Do 26 V6) *Span:* 30 m (98 ft 5 in) *Length:* 24.6 m (80 ft 8½ in) *Gross weight:* 22 500 kg (49 604 lb) *Maximum speed:* 324 km/h (201 mph)

The Dornier Do 26 had a brief operational career in 1940. As part of 1 Staffel of Küstenfliegergruppe 406 the five Do 26s were used in Operation Weserübung from troop transports and resupply. Two were shot down by fighters for No 46 (F) Squadron RAF as they were attempting to land troops in Rombaksfjord on May 28, 1940. After the operations in Norway the remaining Do 26s were withdrawn from front-line service. They continued to operate on communications tasks until the lack of spares and servicing problems necessitated their withdrawal from service

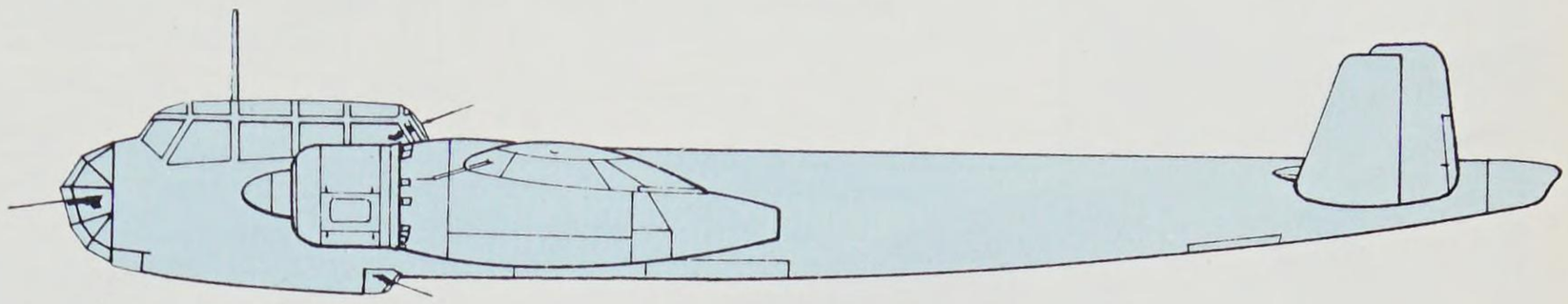
The Do 26 V1 (D-AGNT 'Seeadler') taking off with pusher airscrew extension shafts raised

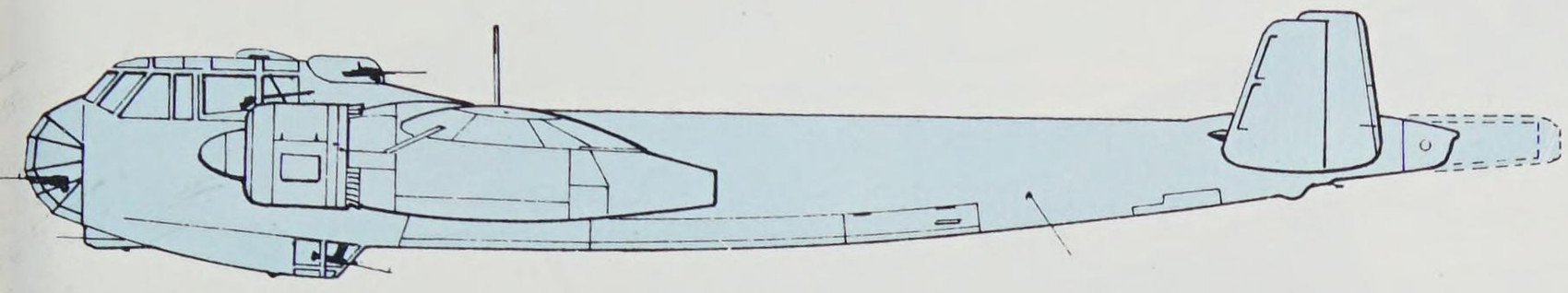




Left: The Dornier Do 217 V1 first flew in August 1938. It was developed from the basic Do 17 design but was stressed for heavier loads and had a dive brake fitted in the tail which opened out like an umbrella when the aircraft was used as a dive-bomber

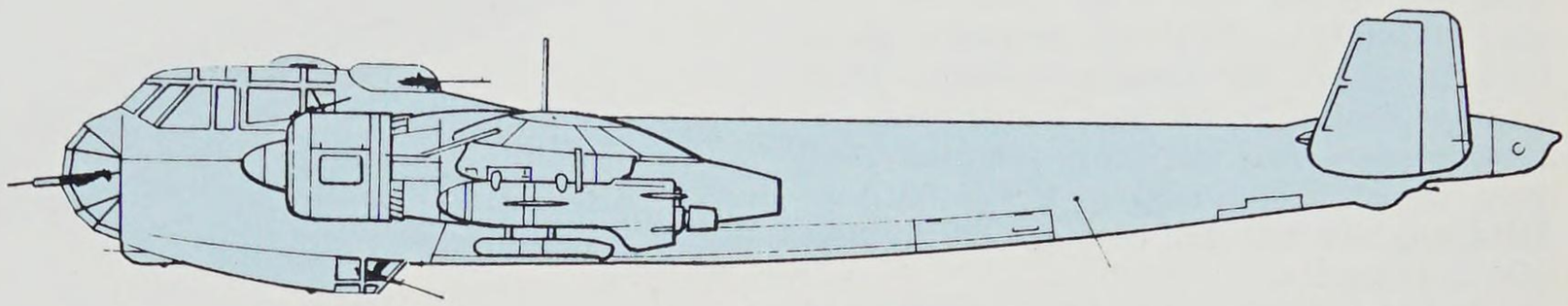
Right: The Do 217 V7 abandoned the dive brake fitted in the V1 which had rarely been used since the bomber was better suited for level attacks than dive-bombing. The V7 was the first of the series to be powered by radial engines

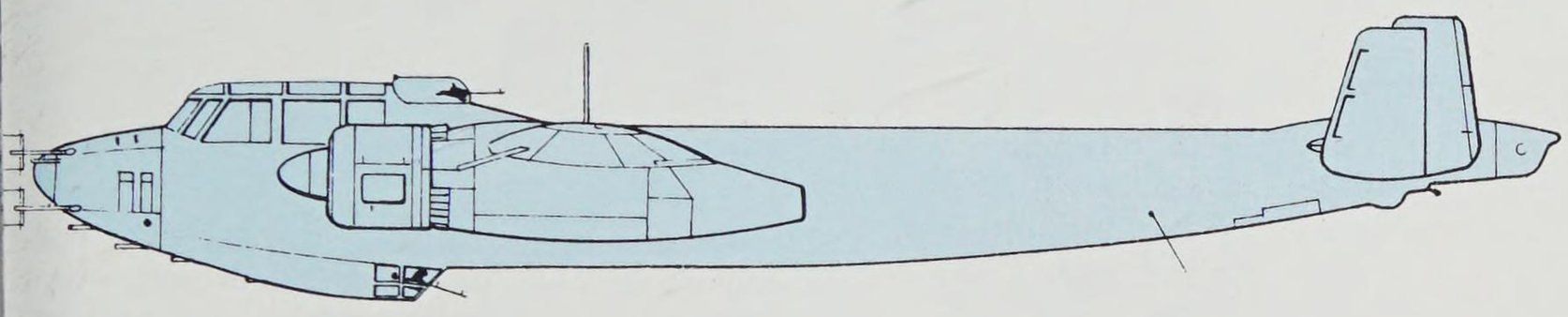




Left: The Do 217E-2 was initially intended as a dive-bomber and was fitted with an umbrella dive brake. It carried a 1000 kg (2200 lb) bombload, had a 13-mm MG 131 in a power-operated dorsal turret, another in a ventral position, and mgs in the cockpit

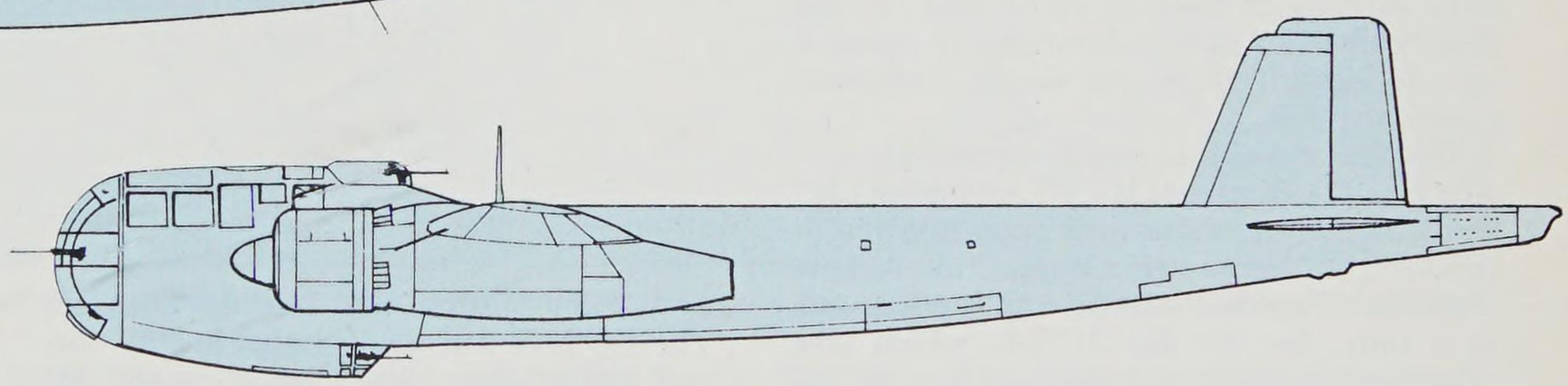
Right: The Dornier Do 217E-5. This was the final production model of the E series and was designed to carry the Henschel Hs 293 rocket-powered radio-controlled glide bomb on pylons outboard of the engine nacelles. Do 217E-5s saw action with the Luftwaffe in the Mediterranean against the Royal Navy, US Navy and co-belligerent Italian warships

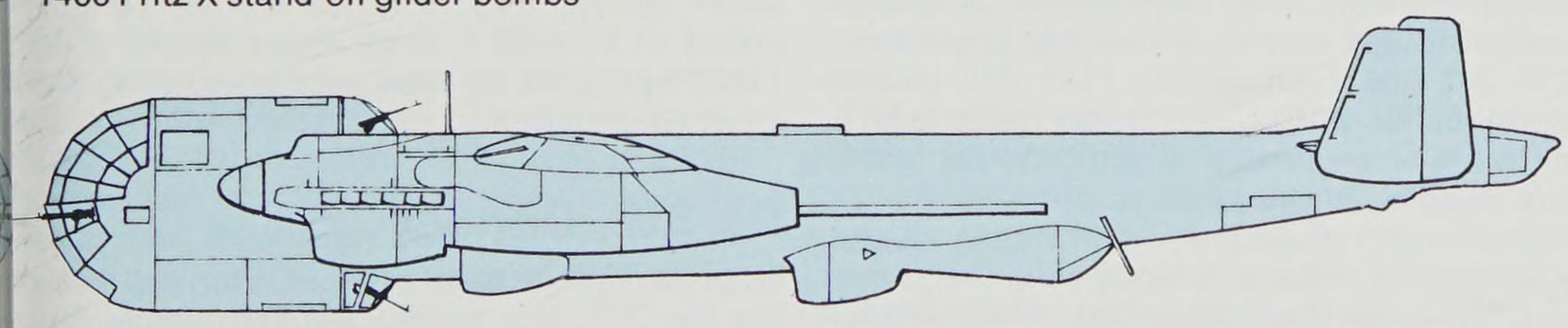




Left: The Do 217J-2 night fighter version of the Dornier bomber had a solid nose mounting four cannon, four machine-guns and a FuG 202 Lichtenstein airborne radar. Besides operating in Germany as part of the 'Kammhuber Line' the Do 217J-2 was supplied to Italy

Right: The Do 217K V1, the prototype of the K series which was flown with a single fin and rudder assembly. The K1 had an R25 tail housing to take the Perlon braking parachute which became a standard feature in later models. Though intended as a night bomber the K series could carry four L5 torpedoes or FX 1400 Fritz X stand-off glider bombs





Left: The Do 217P-O was a high altitude reconnaissance aircraft, though it could carry two 500-kg (1100-lb) bombs on underwing racks or two 900-litre (198-Imp gal) auxiliary tanks. It carried one Rb 20/30 camera and two Rb 75/30 as a reconnaissance aircraft, but a minimum of defensive armament principally because it flew out of range of enemy fighters

Do 217, Dornier

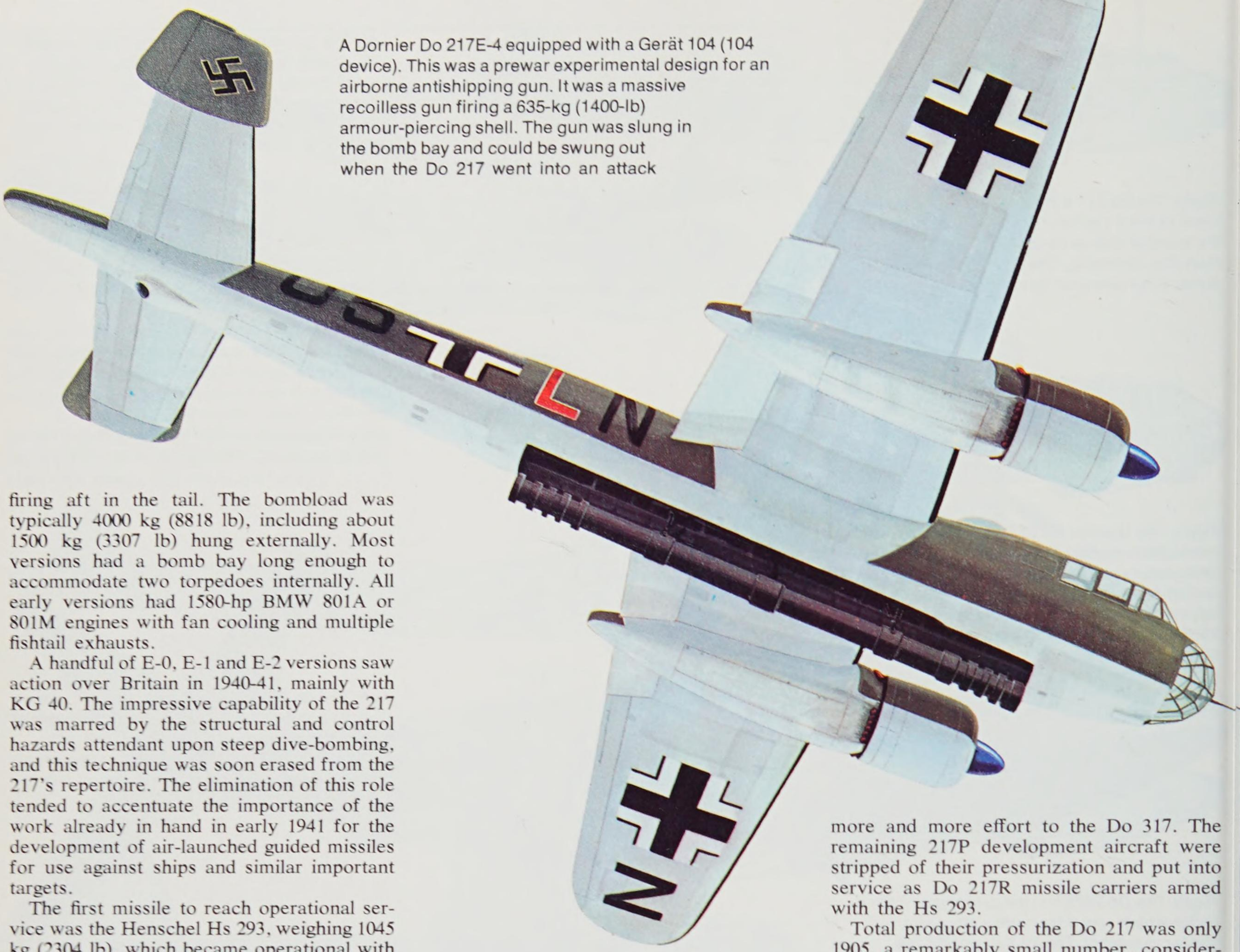
German bomber, night fighter and missile platform. The Do 217 was one of the few completely new bombers to enter service with the Luftwaffe after the start of the Second World War. Though similar in configuration to the much earlier Do 17 series, it had a totally different structure and was much larger and more powerful. Like the contemporary Fw 190, the Do 217 was an all-electric aircraft.

The first prototype, the Do 217 VI, first flew in August 1938, but, with two 1150-hp DB 601 engines, was underpowered. Several prototypes followed, with the Jumo 211 of similar power, until the V7 of 1939 found more power with two of the 1550-hp BMW 139 radials. This engine, however, was not put into production and, like the Fw 190, the Do 217 changed to the heavier but more powerful BMW 801, rated at 1600 hp. Dornier had prolonged difficulties in achieving acceptable flying qualities and clearing the Do 217 for level and dive bombing, torpedo dropping, minelaying and, later, reconnaissance, ground attack, antishipping strike and night fighting. The problem of poor handling was partially solved by the addition of fixed slots along the leading edges of the twin fins.

In most versions a crew of four was accommodated, close together but in fair comfort, in the nose compartment. The wing had hot-air de-icing and accommodated flexible fuel cells between the spars, which passed through the top of the fuselage above the extremely large bomb bay. Early sub-types had a unique petal-type dive-bombing airbrake forming a long tailcone, but this was fairly soon abandoned.

Various armament schemes were fitted to prototypes and the E-0 and E-1, but the first major sub-type, the E-2, had a fixed MG 151/15 forward-firing cannon, an MG 131 in the dorsal turret, an MG 131 aimed manually from the lower rear and two to four 7.92-mm (0.312-in) MG 15 aimed from nose and beam windows. Subsequent bomber versions had MG 81 machine-guns in place of the MG 15, often in neat pairs; the R19 *Rüstsatze pack* (field-modification kit) added four MG 81

Do 317



A Dornier Do 217E-4 equipped with a Gerät 104 (104 device). This was a prewar experimental design for an airborne antishipping gun. It was a massive recoilless gun firing a 635-kg (1400-lb) armour-piercing shell. The gun was slung in the bomb bay and could be swung out when the Do 217 went into an attack

firing aft in the tail. The bombload was typically 4000 kg (8818 lb), including about 1500 kg (3307 lb) hung externally. Most versions had a bomb bay long enough to accommodate two torpedoes internally. All early versions had 1580-hp BMW 801A or 801M engines with fan cooling and multiple fishtail exhausts.

A handful of E-0, E-1 and E-2 versions saw action over Britain in 1940-41, mainly with KG 40. The impressive capability of the 217 was marred by the structural and control hazards attendant upon steep dive-bombing, and this technique was soon erased from the 217's repertoire. The elimination of this role tended to accentuate the importance of the work already in hand in early 1941 for the development of air-launched guided missiles for use against ships and similar important targets.

The first missile to reach operational service was the Henschel Hs 293, weighing 1045 kg (2304 lb), which became operational with II/KG 100 based at Cognac in August 1943.The Henschel missile was carried, two at a time, by the Do 217E-5, which was otherwise changed only by addition of the radio guidance equipment. Two days after the introduction of the missile, II/KG 100 attacked and sank the corvette HMS *Egret*. Substantial numbers of E-series bombers served on the Eastern Front from 1942, while the only Do 217 *Geschwader* (wing) to remain in the West, Kg 2, lost 65 of its original 88 crews between May and September of that year in sporadic missions against Britain.

With the Do 217K-1 a more capacious crew compartment was introduced, similar to that of the He 177 and rather like a Ju 188. Most of this series had the 1700-hp BMW 801D, and the extra power enabled the wing of the K-2 version to be extended to 24.8 m (81 ft 4½ in) to lift two of the formidable 1567-kg (3455-lb) FX-1400 radio-controlled free-fall missiles on racks under the inner wings. Major Bernhard Jope's III/KG 100 became operational with the FX missile on the Do 217K-2 in the late summer of 1943. They worked up at Graz, moved to Istres (Marseilles) and were ready when the Italian fleet sailed from La Spezia to join the Allies on September 9, 1943. Six K-2s sank the flagship, *Roma*, which went down with all 1255 men, and crippled *Italia*. Later Jope himself hit HMS *Warspite* and his unit sank or damaged other Allied ships during the Salerno landings.

The Do 217J was a somewhat hastily contrived night fighter, some being rebuilt 'E'-series bombers with heavy nose armament and with light bombs in the rear bomb bay. The J-2 had Lichtenstein FuG 202 (sometimes and/or FuG 212) airborne radar, with a different arrangement of guns and the bomb bay filled with ammunition. Most of the 'J'-series were passed to the Italian Regia Aeronautica (later Aviazione della RSI, after the September 1943 armistice) to help defend Milan and Turin by night.

A modest production run of Do 217M bombers in 1943 had the 1750-hp DB 603A engine, while a nightfighter conversion of this model was the 217N. Some of the N-series, such as the N-2/R22, had four MG 151 cannon firing steeply upwards at an angle usually near 70° in the so-called 'Schräge Musik' scheme.

The Do 217P was planned as a high-altitude reconnaissance bomber with pressurized cabin and two DB 603B engines fed with boosted mixture by a vast supercharger in the fuselage driven by a DB 605T. Although the P looked knobbly and bristled with engine inlets, radiators and intercoolers, it could fly at over 15240 m (50000 ft) and exceed 585 km/h (363 mph). It would have been very difficult to intercept, but Dornier switched more and more effort to the Do 317. The remaining 217P development aircraft were stripped of their pressurization and put into service as Do 217R missile carriers armed with the Hs 293.

Total production of the Do 217 was only 1905, a remarkably small number, considering the importance of this series on many fronts. Of these, 1541 were offensive, the other 364 being night fighters.

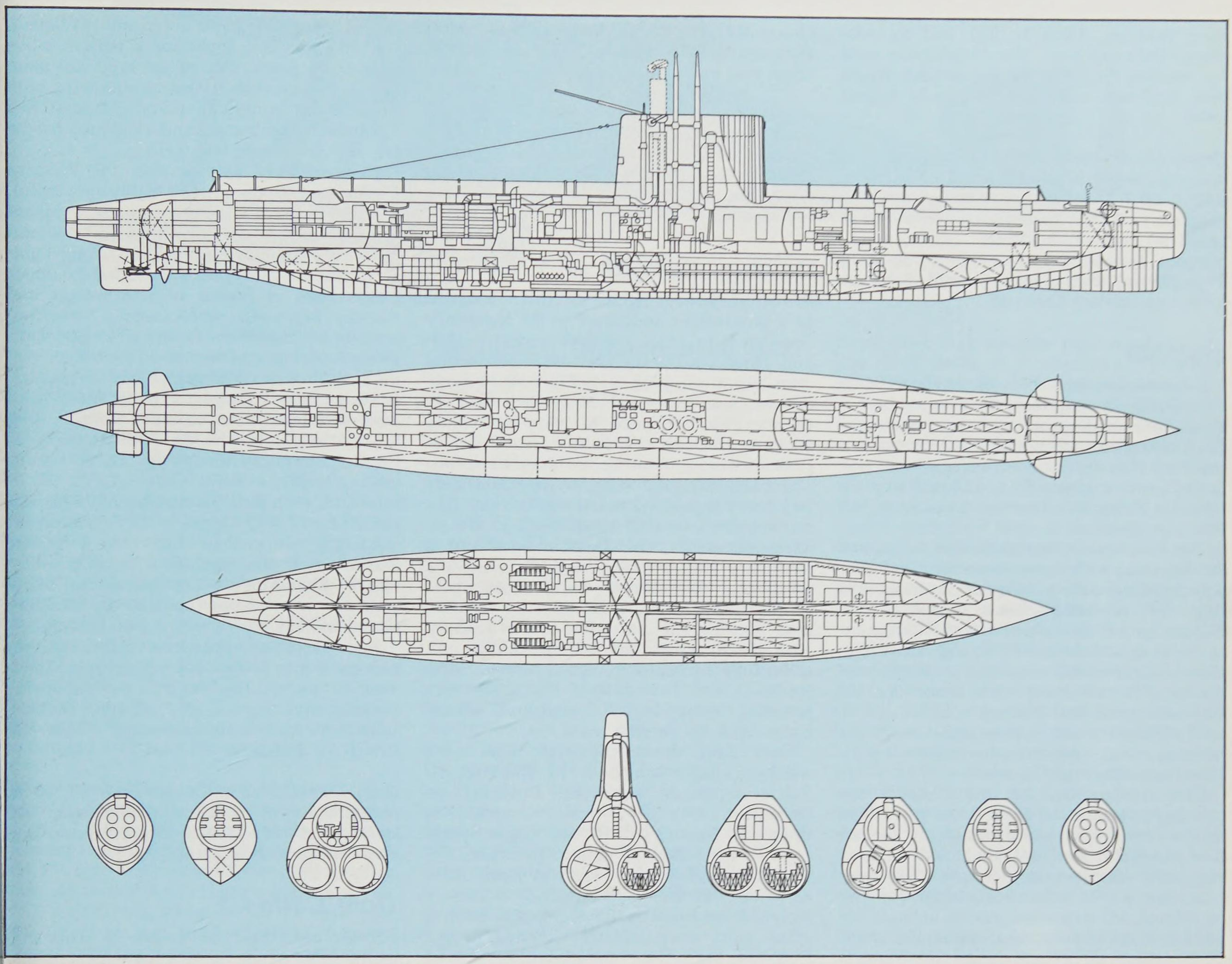
Span: (except K-2) 19 m (62 ft 4 in) *Length:* (most) 17.3 m (56 ft 9 in) *Gross weight:* (E-2) 15000 kg (33069 lb) *Maximum speed:* (E-2) 515 km/h (320 mph)

Do 317, Dornier

German high-altitude bomber. Derived from the Do 217, this potentially formidable aircraft was designed in 1939 to meet the Luftwaffe's Bomber B specification. Dropped in 1940 to allow work to be hastened on the Do 217P, the 317 was resurrected in 1941 in two forms. The 317A was little more than a pressurized 217, while the 317B had a much greater span, completely new engines, remote-control cannon barbettes and a bombload of 5600 kg (12346 lb), with an overload option of two 1800-kg (3968-lb) bombs on wing racks. The 317 was dropped in 1943.

Span: (317B) 25.9 m (85 ft) *Length:* 16.8 m (55 ft 1½ in) *Gross weight:* (317B) 24000 kg (52911 lb) *Maximum speed:* (317B) 670 km/h (416 mph)

Do 335, Dornier German fighter aircraft
See **Pfeil**



The Dutch *Dolfijn* Class showing the unique hull design comprising three cylinders arranged in a triangular shape for strength and roominess

Dolfijn

Dutch submarine class, built 1954-66. In 1949 unds were voted for four submarines to be built for the Dutch navy. Design proved a protracted affair, and took five years to incorporate the latest developments, by which time the money could only cover two boats; the other pair were deferred for nother eight years.

The design is unique in having three separate hulls, arranged in a triangle; the upper ylinder houses the crew, navigational equipment and the torpedo tubes, and the lower wo contain the batteries and propulsion unit. The later pair, *Potvis* and *Tonijn,* incorporated several improvements, and were treated as a separate class, but the first pair *Dolfijn* and *Zeehond,* were later brought up to the same standard, and all four are virtually identical.

The design was drawn up by the distinguished Dutch ship designer M T Gunning, and although it is claimed to give increased strength for deep diving it has not been repeated in subsequent boats. The maximum diving depth is reported to be 300 m (984 ft). All four have had a prominent sonar dome added on the bow to house the Hollandse Signaalapparaten M8 fire-control sonar.

Displacement: 1494/1826 tons (surfaced/submerged) *Length:* 79.5 m (260 ft 9¾ in) oa *Beam:* 7.8 m (25 ft 7 in) *Draught:* 4.8 m (15 ft 9 in) *Machinery:* 2-shaft diesel/electric, 3100 bhp/4400 shp=14½/17 knots (surfaced/submerged) *Armament:* 8 53-cm (21-in) torpedo tubes (4 bow, 4 stern) *Crew:* 64

No and name	launched	builder
S.808 *Dolfijn*	5/1959	Rotterdam Dry Dock company
S.809 *Zeehond*	2/1960	Rotterdam Dry Dock company
S.804 *Potvis*	1/1965	Wilton-Fijenoord, Schiedam
S.805 *Tonijn*	6/1965	Wilton-Fijenoord, Schiedam

Dolphin

US submarine, built 1930-32. The *Dolphin* was the seventh in the big 'V'-series submarines ordered since 1916. However, the previous six had all proved unsuccessful in one way or another, and so the seventh of the series was designed to displace only half as much as the previous *Narwhal* Class. Her designation was to be SC.3 (cruiser submarine), later changed to SF.10 (fleet submarine) but finally SS.169 was adopted. The expedients to save weight included saddle-tanks, lighter scantlings, and reduced oil fuel stowage. This last feature cut her endurance and made her unsuitable for the Pacific, but she proved much handier than the earlier fleet boats.

The *Dolphin* was known temporarily as V 7 and later as D 1, and wore the pendant number D1 on her conning tower for some time, but this confusing system was dropped, and eventually she used only SS.169 as a hull-designation. She was launched at Portsmouth

navy yard on March 3, 1932, and commissioned the same year. The *Dolphin* was used for training for most of the Second World War, and was sold for scrapping in August 1946.

Displacement: 1560/2240 tons (surfaced/submerged) *Length:* 97.31 m (319 ft 3 in) oa *Beam:* 8.46 m (27 ft 9 in) *Draught:* 4.04 m (13 ft 3 in) *Machinery:* 2-shaft diesel-electric drive, 3500 bhp/1750 shp=17/8 knots (surfaced/submerged) *Armament:* 1 4-in (102-mm)/50-cal; 6 21-in (53-cm) torpedoes (4 forward, 2 aft, 18 torpedoes carried) *Crew:* 60

Dolphin

US submarine, built 1962-68. In Fiscal Year 1961 Congress authorized the construction of an experimental submarine for research into deep diving and oceanography. Although not intended for operational service she was armed with a single 21-in (53-cm) torpedo tube for firing experimental torpedoes, but this was removed in 1970.

The *Dolphin* has been elaborately equipped for her role, with three computer-aided systems, one for safety, one for hovering, and one for an undisclosed purpose. On November 24, 1968, three months after commissioning, she descended to a greater depth than any previously recorded by a true submarine. The cylindrical hull is about 4.6 m (15 ft) in diameter, and is constructed of HY-80 steel; fibreglass and aluminium is used in the conning tower (sail) and other non-vital positions to keep weight down.

The configuration of the *Dolphin* has changed; a prominent sonar dome was added on the bow-casing, and the height of the sail was increased. Her hull-number SS.555 was originally allocated to a *Tench* Class boat cancelled in 1945 before being laid down. The additional AG letter-designators indicate her auxiliary and experimental status, but she is nevertheless in normal commission, and is assigned to the Submarine Development Group 1 at San Diego. She was launched at Portsmouth naval shipyard on June 8, 1968, some two years later than planned.

Displacement: 800 tons (standard), 930 tons (full load) *Length:* 46.3 m (152 ft) *Beam:* 5.9 m (19 ft 3 in) *Draught:* 5.5 m (18 ft) *Machinery:* 1-shaft diesel/electric, 1500 bhp=12 knots (submerged) *Armament:* 1 21-in (53-cm) torpedo tube (later removed) *Crew:* 24

Dolphin, Sopwith 5F.1

British single-seat fighter aircraft. Designed as a progressive successor to the legendary Sopwith F.1 Camel, the first prototype Dolphin passed out of the Sopwith experimental department on May 23, 1917. A two-bay biplane, with backward-staggered wings, the Dolphin was designed to carry two fixed Vickers guns and two hand-operated Lewis guns forward and above the pilot's cockpit. The back-staggered wing arrangement gave its pilots a superb view, but was less satisfactory in the event of crash-landing. Unlike its predecessors, the Dolphin employed a stationary, water-cooled engine, giving the machine a distinct nose-heavy appearance. Progressive testing and modification resulted in a large production order, and in January 1918, 19 Squadron, the first operational unit to be fully equipped, received replacements for its former French Spad S7s; a fact perpetuated today in 19 Squadron's official badge with its dolphin motif.

Only three more RFC/RAF units were wholly Dolphin-equipped. In England, 79 Squadron began receiving Dolphins on December 15, 1917; then proceeded to France in February 1918, and began operations in the following month. In France, 23 squadron replaced its Spads in April 1918; while later in the same month 87 Squadron arrived from England fully equipped. Several other units were initially intended to use Dolphins, but in the event used other types of aircraft. A small number of Dolphins were issued to home defence units, and 141 Squadron operated one flight for a period; while large-scale production of the type was planned in France with a view to equipping both French and American units. At least five examples were bought and evaluated by the US Air Service in late 1918.

In operational service over the Western Front, the Dolphin proved highly successful, having the distinct advantage of a higher fighting ceiling than most of its contemporaries. Although ostensibly a four-gun fighter, in practice most pilots discarded the upper Lewis guns in favour of less weight and thereby improved performance. Nevertheless, in 87 Squadron at least, several Dolphins experimented with fixed Lewis guns on the lower wings. When employed on ground-strafing duties, Dolphins were fitted with under-fuselage racks to carry four 11.3-kg (25-lb) Cooper bombs. In combat, many of the Dolphin pilots ran up appreciable victory tallies, such as F W Gillet, DFC, of 79 Squadron (17), R B Bannerman of 79 Squadron (16) and A D Carter of 19 Squadron (at least nine victories in Dolphins). A further indication of the machine's fighting ability was 87 Squadron's claims for a total of 89 combat victories—all claimed by Dolphin pilots, in only seven months of fighting.

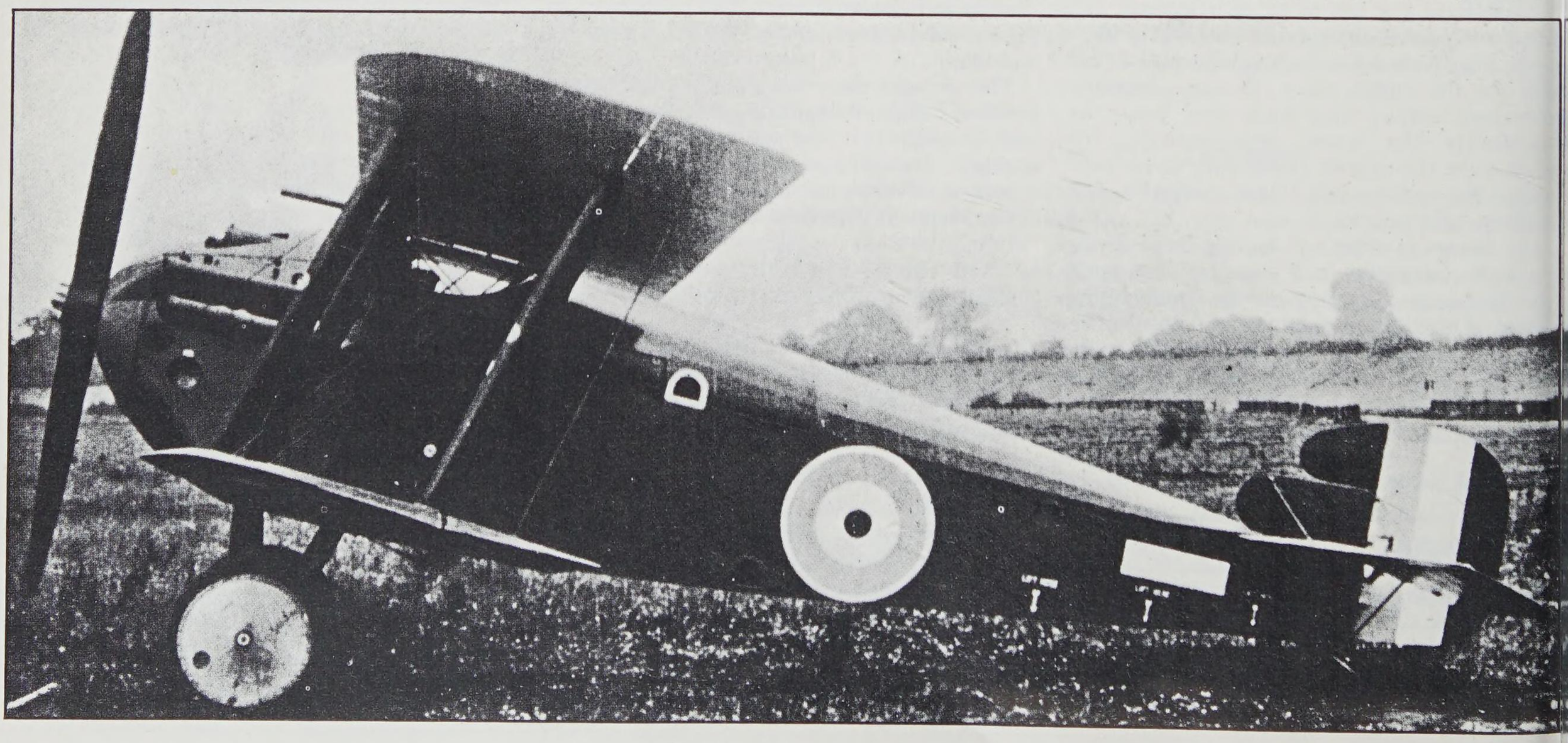
Just before the Armistice a further Dolphin unit came into being—No 1 Squadron, Canadian Air Force—but this unit saw no operational service. By mid-1919, all other Dolphin squadrons had been disbanded within the Royal Air Force.

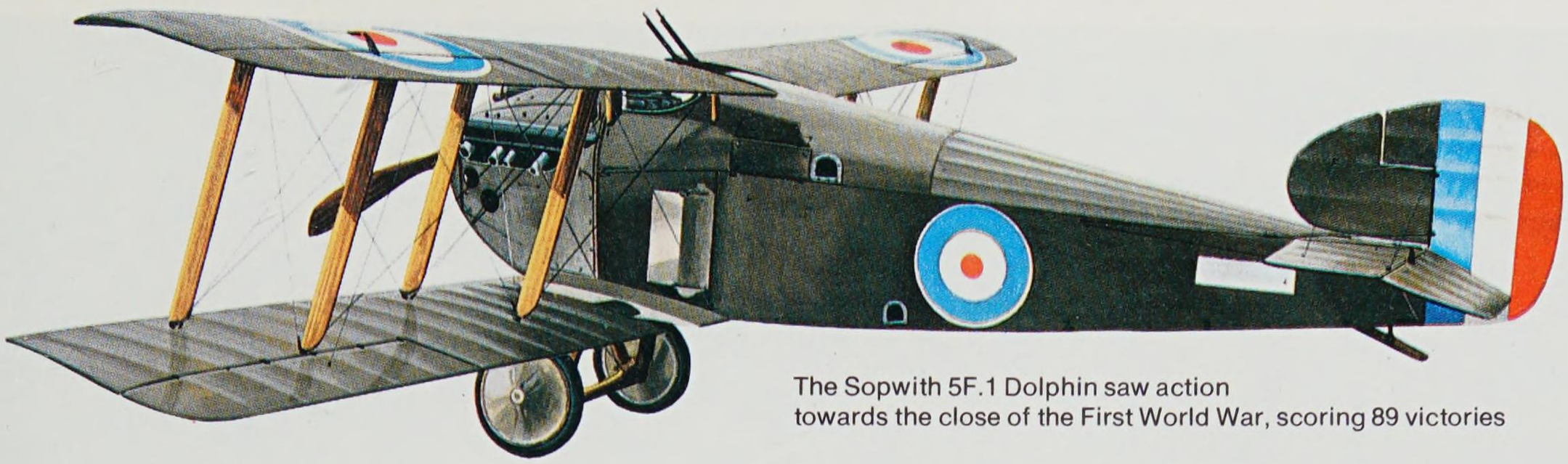
Span: 9.9 m (32 ft 6 in) *Length:* 6.8 m (22 ft 3 in) *Height:* 2.6 m (8 ft 6 in) *Maximum speed:* 205 km/h (127.5 mph) (200-hp Hispano-Suiza) *Service ceiling:* 6400 m (21 000 ft)

Dom Carlos 1

Portuguese cruiser, built 1896-99. This ship was another of the famous 'Elswick' cruisers built at Elswick-on-Tyne by Armstrong-

The modified prototype of the Sopwith Dolphin with a new tail-unit and horn-balanced rudder. Its official tests took place in August 1917





The Sopwith 5F.1 Dolphin saw action towards the close of the First World War, scoring 89 victories

Whitworth. She was the first Elswick cruiser to have Yarrow water-tube boilers, and made 22.15 knots under forced draught on trials.

Laid down as Job No 669 in December 1896, she was launched on May 5, 1898, and started her trials the following March. In layout and appearance she followed the lines of other Tyne-built cruisers, with the 6-in (152-mm) guns disposed singly on the forecastle and poop and sided at the break of the forecastle, and the 4.7-in (120-mm) guns sided further aft in the waist. She had two tall funnels, and double fighting tops on each mast; the lower top on the mainmast was later turned into a searchlight platform and the upper top became a fire-control platform.

She played a prominent role in the revolution of 1910, after which her name was changed to *Almirante Reis*, as being more appropriate to a republic. She was partially dismantled and sold for scrapping in 1923.

Displacement: 4253 tons (normal) *Length:* 109.7 m (360 ft) pp *Beam:* 14.2 m (46 ft 6 in) *Draught:* 5.3 m (17 ft 6 in) *Machinery:* 2-shaft 4-cylinder triple-expansion, 8000 ihp= 20½ knots *Protection:* 114 mm (4½ in) deck; 102 mm (4 in) conning tower *Armament:* 4 6-in (152-mm)/45-cal (4×1); 4.7-in (120-mm)/45-cal (8×1); 14 3-pdr (47-mm) QF (14×1); 5 35.56-cm (14-in) torpedo tubes (2 submerged, beam, 3 above water, beam and stern) *Crew:* 473

Dominator, Consolidated B-32

US strategic bomber. In spite of the fact that the B-32 Dominator was second only to the B-29 in size, power and complexity among Second World War bombers, and served in action against Japan, it received little publicity and is not well remembered.

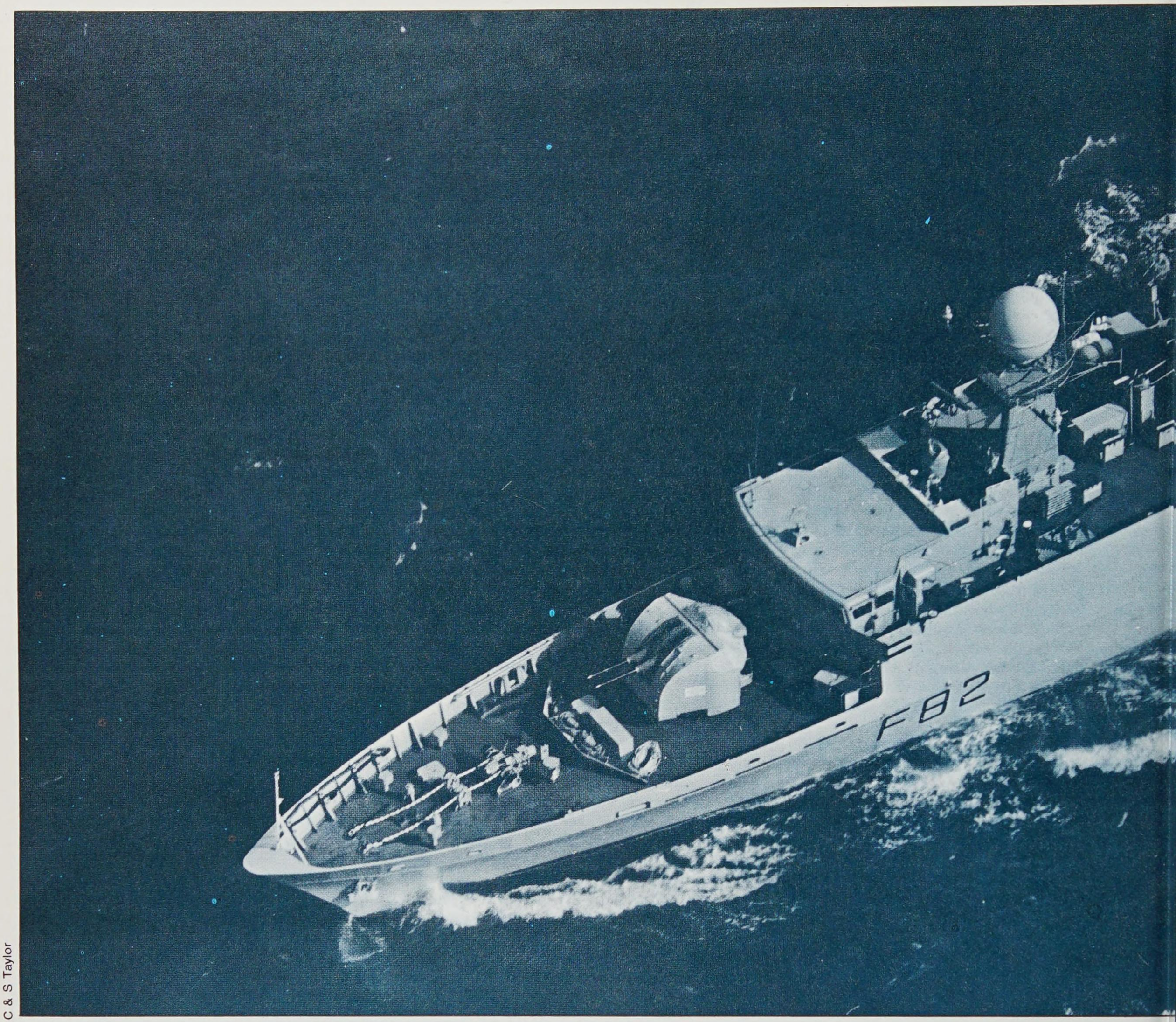
Consolidated were awarded a contract for the XB-32 at the same time as Boeing were given the XB-29, but the first prototype (Model 33) did not fly for two years, the first XB-32 taking the air on September 7, 1942. In configuration a much bigger development of the Model 32 Liberator, the Model 33 had four 2200-hp Wright R-3350-23 Duplex Cyclone engines, each with two GE turbo-superchargers, driving four-blade Curtiss Electric propellers. The fuselage was of more circular section than that of the Liberator, and all crew compartments were pressurized. The nose was like that of the B-29, and the tail had twin fins similar in shape to the Liberator. Unlike the Liberator, the main gears had twin wheels and retracted forward into the inner nacelles (the four nacelles were large and extended aft of the trailing edge). Armament comprised two 20-mm (0.79-in) cannon and 14 0.5-in (12.7-mm) guns in remote-control barbettes.

Technical difficulties were severe. The second XB, flown on July 2, 1943, had a conventional nose with stepped pilot windscreens. The third, flown on November 9, 1943, followed the late-model Liberators in switching to an extremely large single fin and rudder. Large-scale production was planned, and orders were placed for 1700 production B-32 Dominators. However, technical difficulties continued, and to get the programme moving the pressurization and complex remote-control armament were abandoned at a late stage. The B-32 was produced as a strategic bomber cast in the mould of the B-24 Liberator with a typical over-target height of not above 8534 m (28 000 ft).

As put into production in the spring of 1944, the B-32 had five turrets, each housing a gunner and mounting twin 0.5-in (12.7-mm). Internal bomb bays under the wing spans carried 9072 kg (20 000 lb) of bombs. Deliveries began in November 1944, 40 TB-32 crew trainers were used to train crews, and in the final weeks of the war the first unit went into action in the Pacific and flew two combat missions. In the closing days of the war 15 B-32s became operational in the Western Pacific. By VJ-Day 115 B-32s had been delivered, 1588 being cancelled and the type withdrawn from service.

Span: 41.1 m (135 ft) *Length:* 25.3 m (83 ft 1 in) *Gross Weight:* 54 431 kg (120 000 lb) *Maximum speed:* 579 km/h (360 mph)

A Mark II Dolphin fitted with a 300-hp Hispano-Suiza engine. Dolphins saw limited service after the war with the Russian and Polish air forces



C & S Taylor

The Nigerian *Dorina* Class corvette *Otobo* (F.82) on trials in 1976 after her refit by Vosper Thornycroft at their Camber yard in Portsmouth

Donryo Japanese name for Nakajima Ki-49 bomber See **Ki-49**

Dorina

Nigerian corvette class, built 1970-72. Following the success of their Mk 1 corvette design sold to Ghana, Vosper Thornycroft produced a Mk 3 design for Nigeria, 7.6 m (25 ft) longer, 0.76 m (2ft 6in) wider and 3 knots faster. The armament was also heavier, with a twin 4-in (102-mm) Mk 16 antiaircraft gun forward, two single 40-mm (1.57-in) Bofors AA and two 20-mm (0.79-in) Oerlikons.

The design is compact, and follows the lines of other Vosper Thornycroft ships, with a single fat funnel set well back from the bridge. The emphasis is on simplicity of operation and maintenance, but at the same time a weight of armament which makes the ship a useful coastal escort. The main air-warning and surveillance radar is the Plessey AWS-1 and a Hollandse Signaalapparaten M20 fire control outfit is provided.

Dorina (F.81) was laid down in January 1970 and completed in June 1972. Her sister *Otobo* (F.82) was laid down nine months later and was completed in November 1972. Both ships were refitted by the original builders at their Camber yard in Portsmouth in 1975-76. The names mean 'hippopotamus' in two of the main tribal languages used in the Federation of Nigeria.

See also *Kromantse, Erin'mi.*

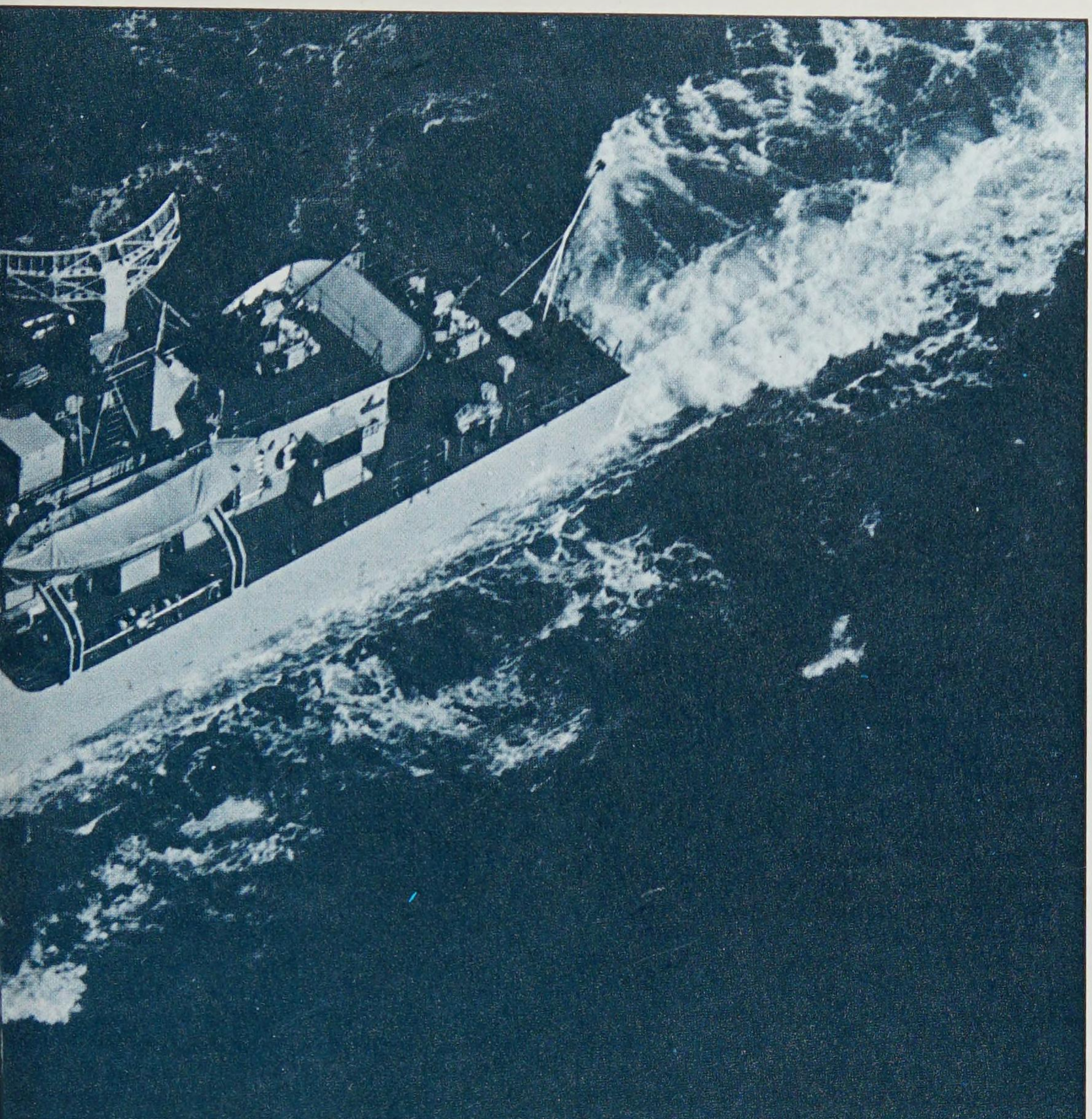
Displacement: 500 tons (standard), 650 tons (full load) *Length:* 61.6 m (202 ft) oa *Beam:* 9.45 m (31 ft) *Draught:* 3.46 m (11 ft 4 in) *Machinery:* 2-shaft diesels, 3400 bhp = 23 knots *Armament:* 2 4-in (102-mm) Mk 16 AA (1×2); 2 40-mm (1.57-in) AA (2×1); 2 20-mm (0.79-in) (2×1) *Crew:* 66

Dornier German aircraft See **Alpha Jet, Do 11/13/23, Do 17, Do 18, Do 22, Do 24, Do 217, Do 317, Pfeil, Skyservant**

Dorsetshire

British cruiser class. These two vessels constructed under the 1926-27 Programme were the third and last group of the 10000 ton 'County' Class Washington Treaty cruisers. The *Dorsetshire* was laid down at Portsmouth dockyard in 1927, launched in 1929 and completed in 1930. The *Norfolk* was constructed by Fairfields, being laid down at Govan in 1927, launched in 1928 and completed in 1930. Two more ships, the *Northumberland* and *Surrey*, of the 1928-29 Programme, were cancelled in 1930.

The *Dorsetshire* and *Norfolk* were basically repeats of the *London* Class but incorporated some new items of gunnery equipment. Chief of these was the Mk II twin 8-in (203-mm) gun mounting which was adopted in place of the Mk I mounting of the *Kent* and *London* Classes. It was originally designed for the cruisers *York* and *Exeter* and was intended to simplify ammunition supply and reduce



weight. In fact, it was heavier than the Mk I. The mounting employed a combined shell and cordite handling room, the magazines and shell rooms being on one level instead of two, which necessitated the rearrangement of the hold and platform deck compartments forward and aft. The 102-mm (4-in) and 76-mm (3-in) thick box protection to the magazines was extended to include the shell rooms which in the previous 'County' Classes were protected by 25-mm (1-in) plating only. These ships also adopted the new power-trained director control tower which replaced the separate director and range finder used for main armament fire control in earlier 'County' ships.

By 1939, the single 4-in (102-mm) antiaircraft guns had been replaced by four twin 4-in (102-mm) dual-purpose gun mountings and two high-angle directors had been fitted. In addition the single 2-pdr guns were removed and 16 2-pdr pom-poms (2×8) and 8 0.5-in (12.7-mm) machine-guns (2×4) fitted for close-range antiaircraft defence. In 1940 the *Norfolk* was fitted with UP (unrotated projectile) rocket launchers on the roofs of B and X turrets. These were subsequently removed together with the 0.5-in (12.7-mm) machine-guns and between 1941 and 1943, 18 *(Dorsetshire* 9) single 20-mm (0.79-in) antiaircraft guns were fitted.

The *Dorsetshire* served mainly in the Atlantic until 1942 when she was transferred to the Eastern Fleet. On April 5, 1942, she was bombed and sunk by Japanese carrier aircraft west of Ceylon. The *Norfolk* oper-

HMS *Norfolk*, a *Dorsetshire* Class cruiser, at anchor on a stormy day. She played a leading part in the sinking of the *Bismarck* in 1941 and *Scharnhorst* in 1943

MOD

HMS *Dorsetshire*, with her **Walrus flying** boat clearly visible amidships and **her hull,** superstructure and funnels **dazzle painted**

MOD

ated with the Home Fleet for most of the war. In May 1941 she took a leading part in the hunt for the *Bismarck* and in December 1943 assisted in the sinking of the *Scharnhorst.* During the latter battle she was in action with the German battlecruiser for some time and, while inflicting damage on her enemy, was herself badly damaged by gunfire.

She was repaired and refitted between January and November 1944, during which time X turret, the aircraft catapult and the torpedo tubes were removed in order to provide space and topweight for additional antiaircraft equipment. The 8-barrel pom-pom mountings were also removed and the number of single 20-mm (0.79-in) guns were reduced to ten while 24 2-pdr pom-poms (6×4) and 22 20-mm (0.79-in) (11×2) AA guns were added. She also had a third high-angle director added and her radar and communications equipment modernized. In September 1945 all her single 20-mm (0.79-in) guns were replaced by single 40-mm (1.57-in) (10×1) Bofors AA guns. After the war she became flagship of the C-in-C East Indies station, was paid off in 1949 and sold for scrap in 1950.

See also *Kent* and *London.*

Displacement: 9900 tons (standard) 13 290 tons (full load) *Length:* 192.84 m (632 ft 8 in) *Beam:* 20.12 m (66 ft) *Draught:* 5.18 m (17 ft) mean *Machinery:* 4-shaft geared steam turbines, 80 000 shp=32.25 knots *Protection:* 102 mm (4 in) and 76 mm (3 in) magazines; 25-38 mm (1-1½ in) decks; 25 mm (1 in) gunhouses *Armament:* 8 8-in (203-mm) (4×2); 4 4-in (102-mm) AA (4×1); 4 2-pdr AA (4×1); 8 21-in (53-cm) torpedo tubes (2×4) *Aircraft:* 1 plus catapult *Crew:* 785

Douglas US aircraft See **B-7, B-18, Cargomaster, Dakota, Dauntless, Destroyer BTD, Destroyer B-66, Devastator, Dragon B-23, DT, Globemaster, Havoc, Invader, Skyhawk, Skynight, Skymaster, Skyraider, Skyray, Skywarrior, T2D/F2D**

Douro

Portuguese destroyer class. One of the most successful destroyer designs ever built was the British type which first appeared as the 'V and W' Class of the First World War. The formula of four 4-in (102-mm) or 4.7-in (120-mm) guns in superfiring mounts fore and aft, two multiple torpedo tube mountings and a seaworthy raised forecastle hull was to be repeated in many destroyers built during the inter-war years. It was not surprising, therefore, that when the Portuguese navy decided on a major building programme in 1930 the type ordered should be a variant of this.

Initially, four were ordered to a design by the firm of Yarrow. Two were to be built by the designers, the remaining two being built under licence at Lisbon. These latter were to be provided with boilers and machinery built by Yarrow, and all four were to be armed by Vickers. Although in general the ships were very similar to their British contemporaries, the machinery was of a special Yarrow design, using steam at 400 pounds working pressure, and the ventilation was intended to cope with service in tropical waters.

All four ships were laid down in 1932, but the Yarrow-built pair were completed first, the lead ship, *Vouga*, reaching Lisbon in July 1933. In 1934 the pair built at Lisbon, *Douro* and *Tejo*, were sold to the South American republic of Colombia and renamed *Antioquia* and *Caldas* respectively. Their crews seem to have consisted of retired Royal Navy officers and men, who had been given special permission to serve under a foreign flag.

Portugal initially ordered two more destroyers to be built to the same design at Lisbon as replacements, and a third seems to have been added almost immediately. Again Yarrow provided the machinery. Between 1946 and 1949 all five of the Portuguese vessels (often known as the *Vouga* Class) were refitted by Yarrow and Vickers. The 2-pdrs were replaced by Bofors 40-mm (1.57-in), and 20-mm (0.79-in) guns were added, as was Asdic (Sonar) and radar. A tripod mast replaced the old foremast. The removal of one set of torpedo tubes, the new aluminium casings on the funnels, and the cutting down of the level of the after funnel helped to compensate for the additional topweight. The machinery was also given a thorough overhaul.

In 1957 another refit to all except the *Douro* removed two 4.7-in (120-mm) guns and increased the Bofors armament by transforming two of the mounts to twins, and Squid antisubmarine mortars were added. The unconverted *Douro* was discarded in 1959, *Dao* followed in 1960, two more in 1965, and *Vouga* was scrapped in 1967.

The two Colombian ships underwent an even more radical transformation during 1952-55, when they were fitted with two American 5-in (127-mm)/38-cal mounts, three twin 40-mm (1.57-in) Bofors, and a Hedgehog antisubmarine weapon instead of their previous gun armament. The torpedo tubes were reduced to a single quadruple mount, and radar and new fire control fitted.

Name	launched	builder
Douro (I)	6/1932	Lisbon
Tejo (I)	11/1933	Lisbon
Dao	7/1934	Lisbon
Douro (II)	8/1935	Lisbon
Lima	5/1933	Yarrow
Tejo (II)	5/1935	Lisbon
Vouga	1/1933	Yarrow

Length: 98.14 m (322 ft) oa, 97.23 m (319 ft) pp *Beam:* 9.45 m (31 ft) *Draught:* 3.35 m (11 ft) *Displacement:* 1219 tons (standard), 1563 tons (full load) *Machinery:* 2-shaft Parsons geared turbines, 33 000 shp=36 knots *Armament:* 4 4.7-in (120-mm) guns; 3 2-pdr (40-mm); 8 21-in (53-cm) torpedo tubes; depth charges; mine rails for 20 mines *Crew:* 163-184

Doxa

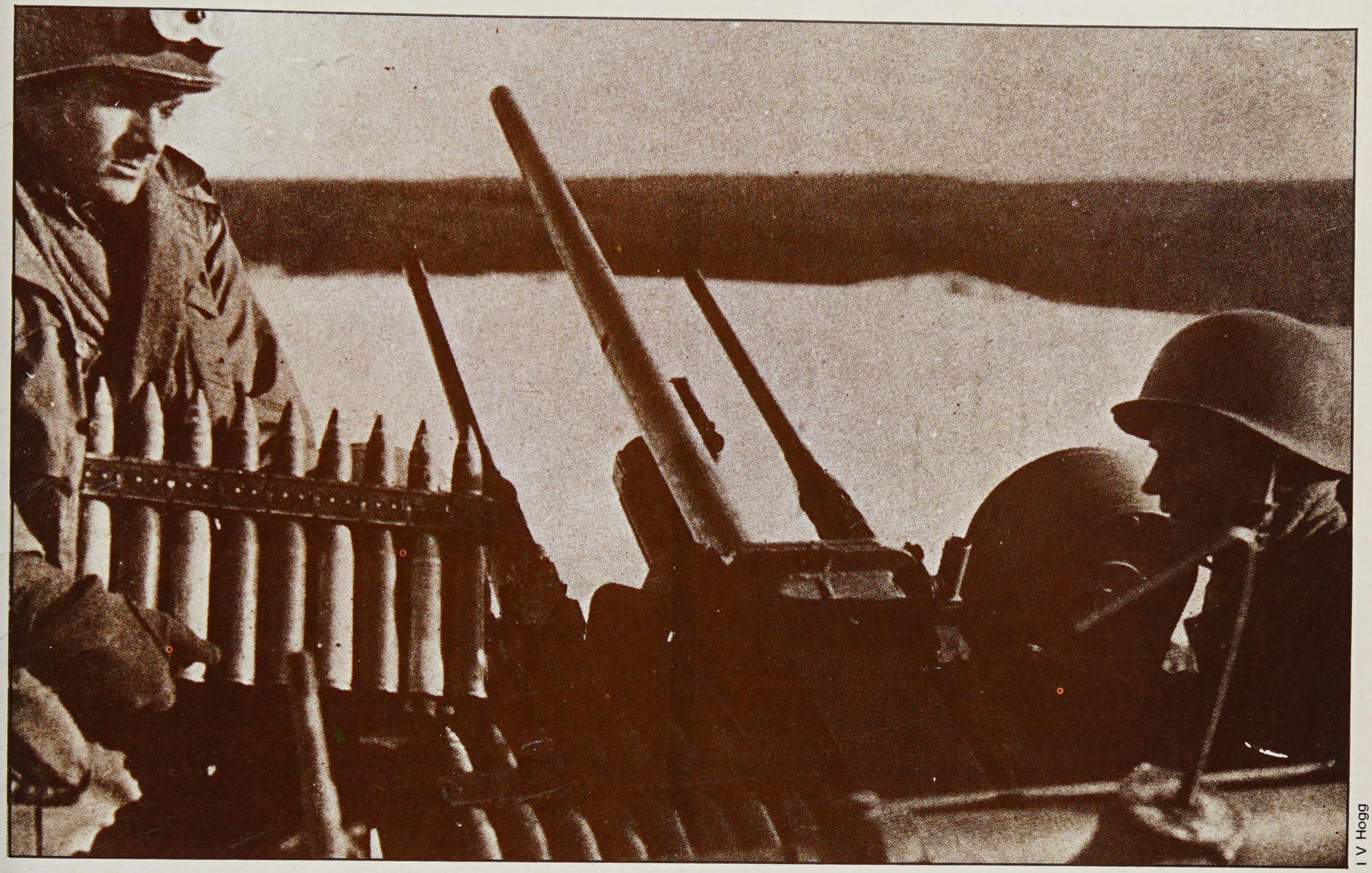
Greek destroyer class, built 1906-07 by the German Vulcan shipyard at Stettin (Sczecin). Although German-built the class, *Aspis, Niki, Doxa* and *Velos*, conformed to British ideas on layout and hull-form, and apart from having the bridge set further back could be mistaken for British '30-knotters'. They were in fact a German edition of the Yarrow-built *Thyella* Class, built at the same time, with the same armament. In appearance they resembled the *Thyella* Class, but with three funnels instead of two, and a prominent mainmast immediately abaft the last funnel.

The *Doxa* was torpedoed by a U-Boat in the Mediterranean on June 27, 1917. Her sisters survived, but *Velos* was sold in 1931. The other two were refitted in 1928-29, and had the mast shifted forward of the bridge. They escaped the Italian attack in 1941 but were only of limited use to the Allies and were scrapped soon after the war.

See also *Thyella* Class.

Displacement: 275 tons (normal), 350 tons (full load) *Length:* 67.13 m (220 ft 3 in) pp *Beam:* 6.25 m (20 ft 6 in) *Draught:* 2.19 m (7 ft 2½ in) normal *Machinery:* 2-shaft reciprocating steam, 6700 ihp=30 knots *Armament:* 2 3-in (76-mm) QF (2×1); 4 57-mm (2.24-in) QF (4×1); 2 17.7-in (45-cm) torpedo tubes (2×1), replaced by 21-in (53-cm) in 1928-29 *Crew:* 70

Antiaircraft Guns



I V Hogg

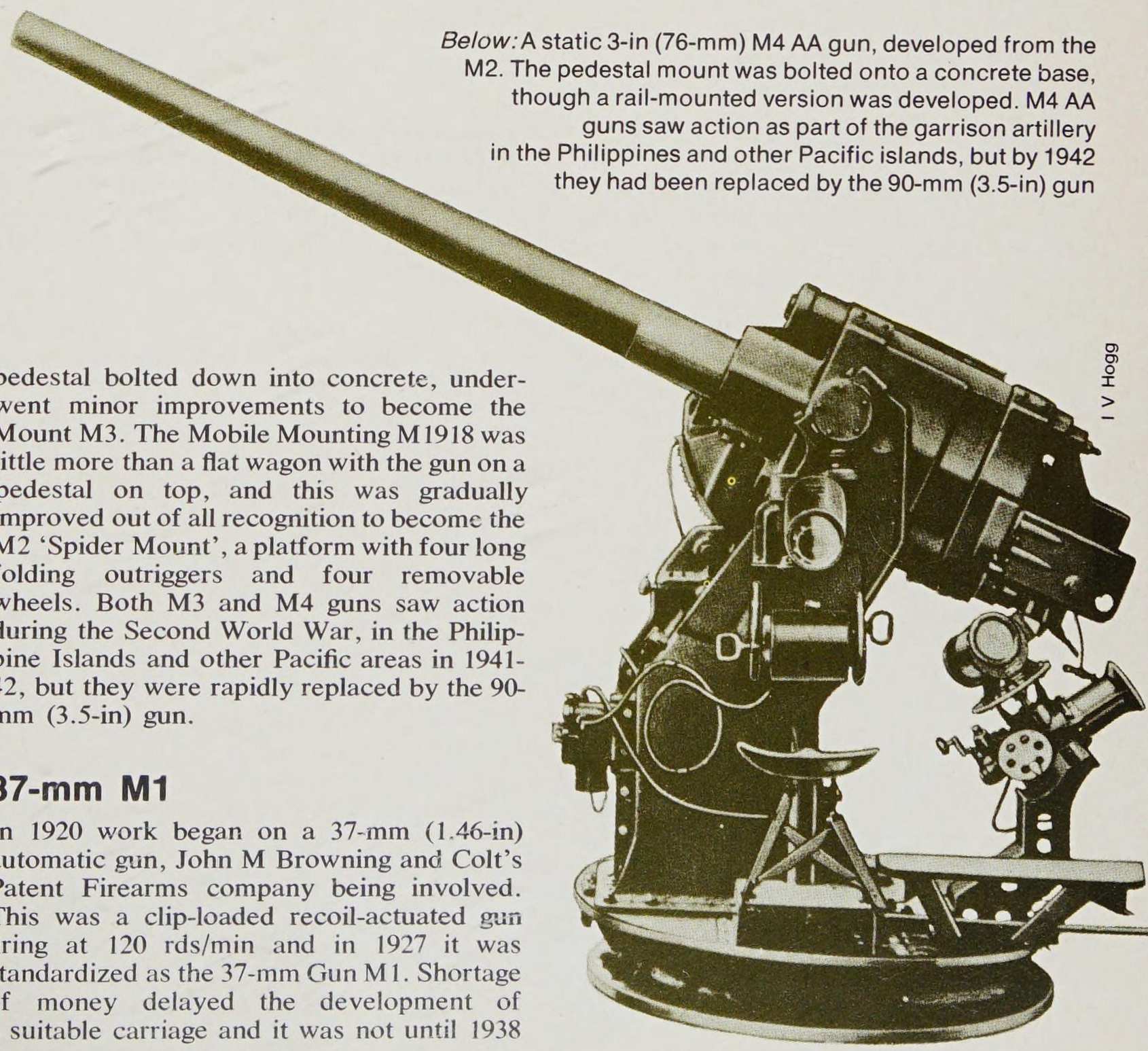
A GI prepares to load a clip of shells into the breech of an M1A2 37-mm AA gun flanked by two .50-in heavy machine-guns on a mount M54

In 1915 the US Ordnance Department began designing an AA gun for static emplacement, and as a basis they took the 3-in (76-mm) Seacoast Gun M1903, a 55-calibre gun, and this eventually became the 3-in AA Gun M1917. After America's entry into the First World War a mobile gun was required, and since a slightly less powerful weapon would simplify the designing of the mounting, the 3-in Seacoast Gun M1898, a 50-calibre gun using a smaller cartridge, was adopted. Manufacture was slow, and the AEF in France was equipped with French 75-mm Autocannons on De Dion chassis. As a temporary expedient, the Modified Improved AA Gun Carriage M1917 was provided, a cumbersome gallows-like contraption into which a field gun barrel—usually that of the 75-mm M1897 gun—could be slung. This was supposed to be mobile, but 'transportable' would have been a better term.

3-in M2, M3, M4

After the war, the 3-in models were gradually improved. The M1917 static gun was a 'built-up' gun with several tubes and hoops, and this is an inconvenient system in a gun which might well fire several hundred rounds in two or three days and then need relining, so the method of manufacture was changed to a simple tube and loose liner to become the M2 gun. This was satisfactory but difficult to make, and it was redesigned with a heavier liner to become the M4. Development of the mobile gun followed similar lines, eventually arriving at the M3.

The original static mounting, a simple pedestal bolted down into concrete, underwent minor improvements to become the Mount M3. The Mobile Mounting M1918 was little more than a flat wagon with the gun on a pedestal on top, and this was gradually improved out of all recognition to become the M2 'Spider Mount', a platform with four long folding outriggers and four removable wheels. Both M3 and M4 guns saw action during the Second World War, in the Philippine Islands and other Pacific areas in 1941-42, but they were rapidly replaced by the 90-mm (3.5-in) gun.



I V Hogg

Below: A static 3-in (76-mm) M4 AA gun, developed from the M2. The pedestal mount was bolted onto a concrete base, though a rail-mounted version was developed. M4 AA guns saw action as part of the garrison artillery in the Philippines and other Pacific islands, but by 1942 they had been replaced by the 90-mm (3.5-in) gun

37-mm M1

In 1920 work began on a 37-mm (1.46-in) automatic gun, John M Browning and Colt's Patent Firearms company being involved. This was a clip-loaded recoil-actuated gun firing at 120 rds/min and in 1927 it was standardized as the 37-mm Gun M1. Shortage of money delayed the development of a suitable carriage and it was not until 1938

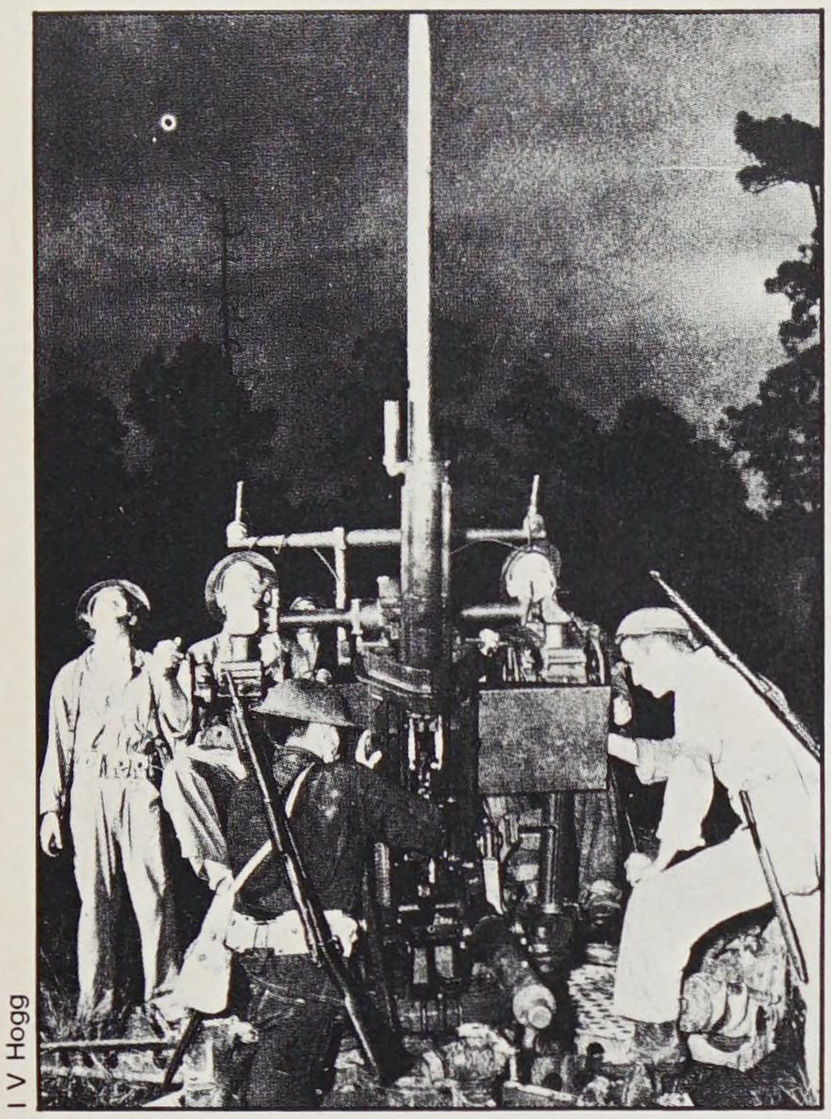
Antiaircraft Guns

Antiaircraft Guns

Men of Battery B, First Antiaircraft Second Division in action on June 5, 1918 near Montreuil in France. They are using a French 75-mm gun M1897—mounted on a De Dion truck. The French had borrowed the idea of a mobile AA unit from the Germans and introduced this equipment in 1910. At that time military thinkers assumed that a motorized AA unit could drive around like a fire brigade whenever an aerial threat arose. By 1918 tactics had changed and this American crew are preparing to put up a rapid barrage. They are linked by Fuller-phone (a type of field telephone) and while three men are assigned to the sights, elevation and line, two are loading with one on the breech. In the background four shells are ready on the fusing machine while more shells are stacked within easy reach. There are two men on the fusing machine, one positioning the shell while the other operates the handles which punch through the lead seal. The gun commander, a sergeant, stands on the far left ready to spur the crew to greater efforts

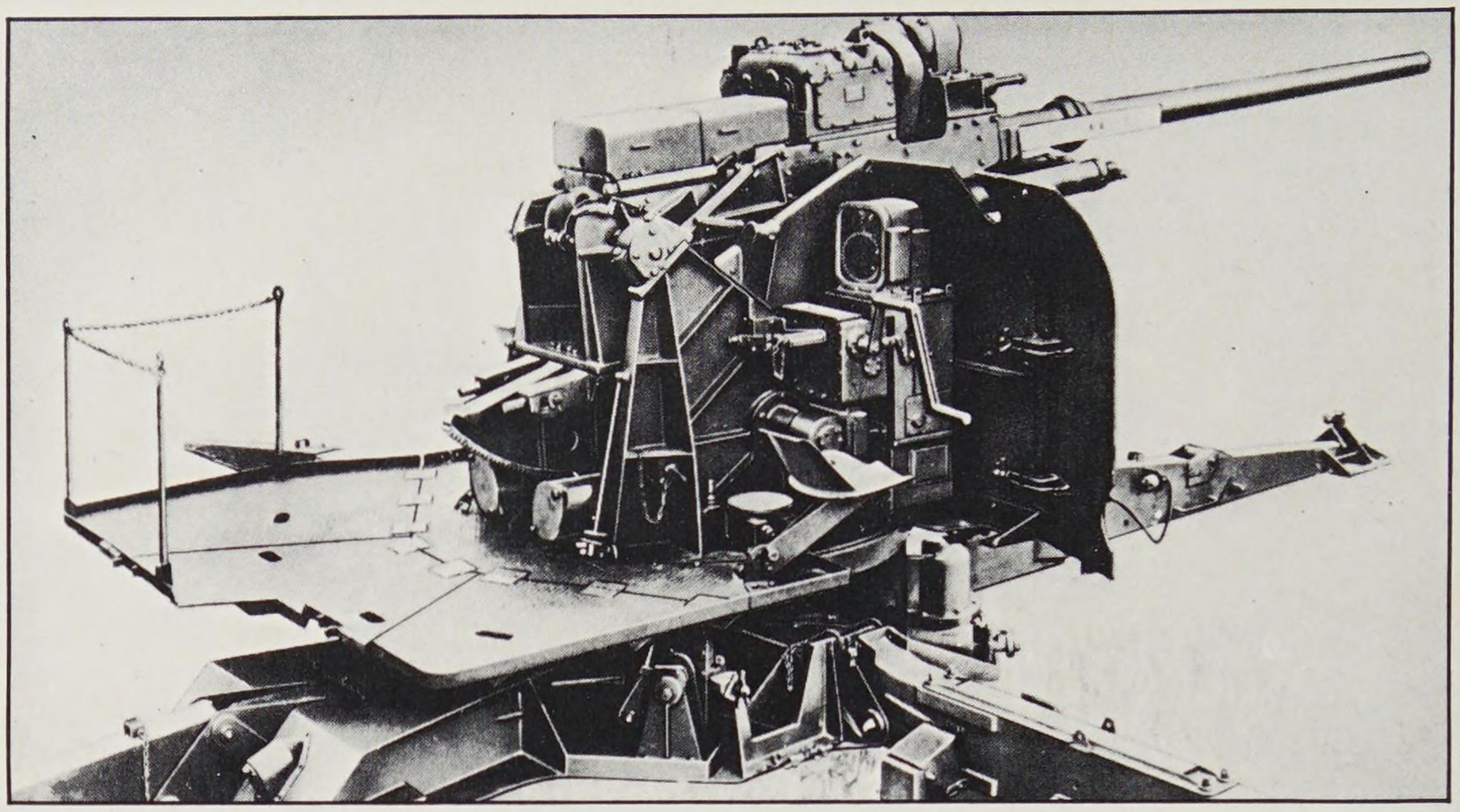
IWM

Antiaircraft Guns



I V Hogg

Troops with a 37-mm AA gun M1—it entered service in 1940 and served throughout the war



I V Hogg

A 90-mm Antiaircraft Gun M2 on mount M2. A fuze setter and ramming mechanism was incorporated in the mount, thus reducing the time before reloading

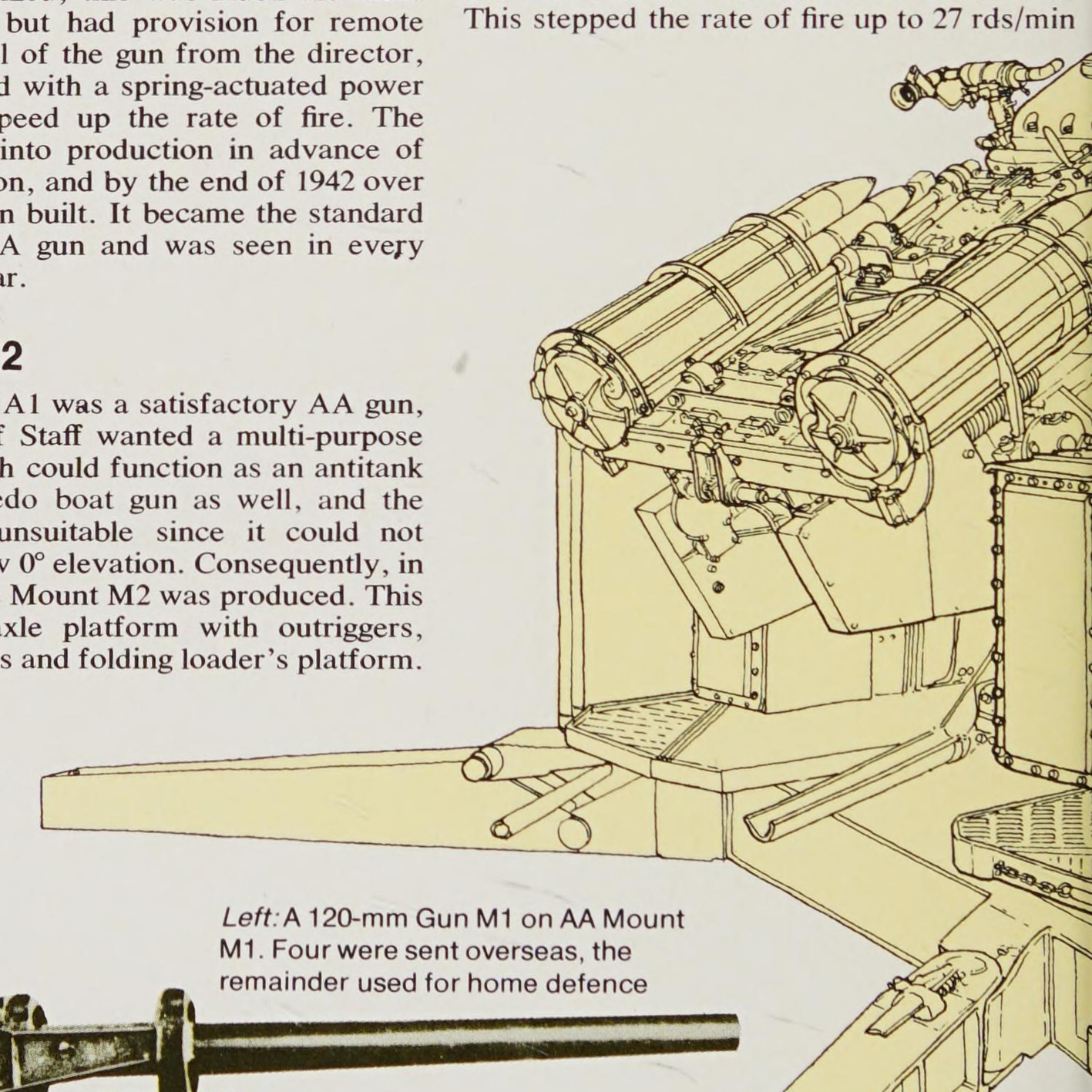
that the complete equipment went into production. Over 7000 were eventually made, and although outclassed by the 40-mm (1.57-in) gun in due course, the 37-mm served throughout the war. Many of the guns were used to equip Multiple Motor Gun Carriages, usually being used in company with two 0.5-in (12.7-mm) Browning machine-guns.

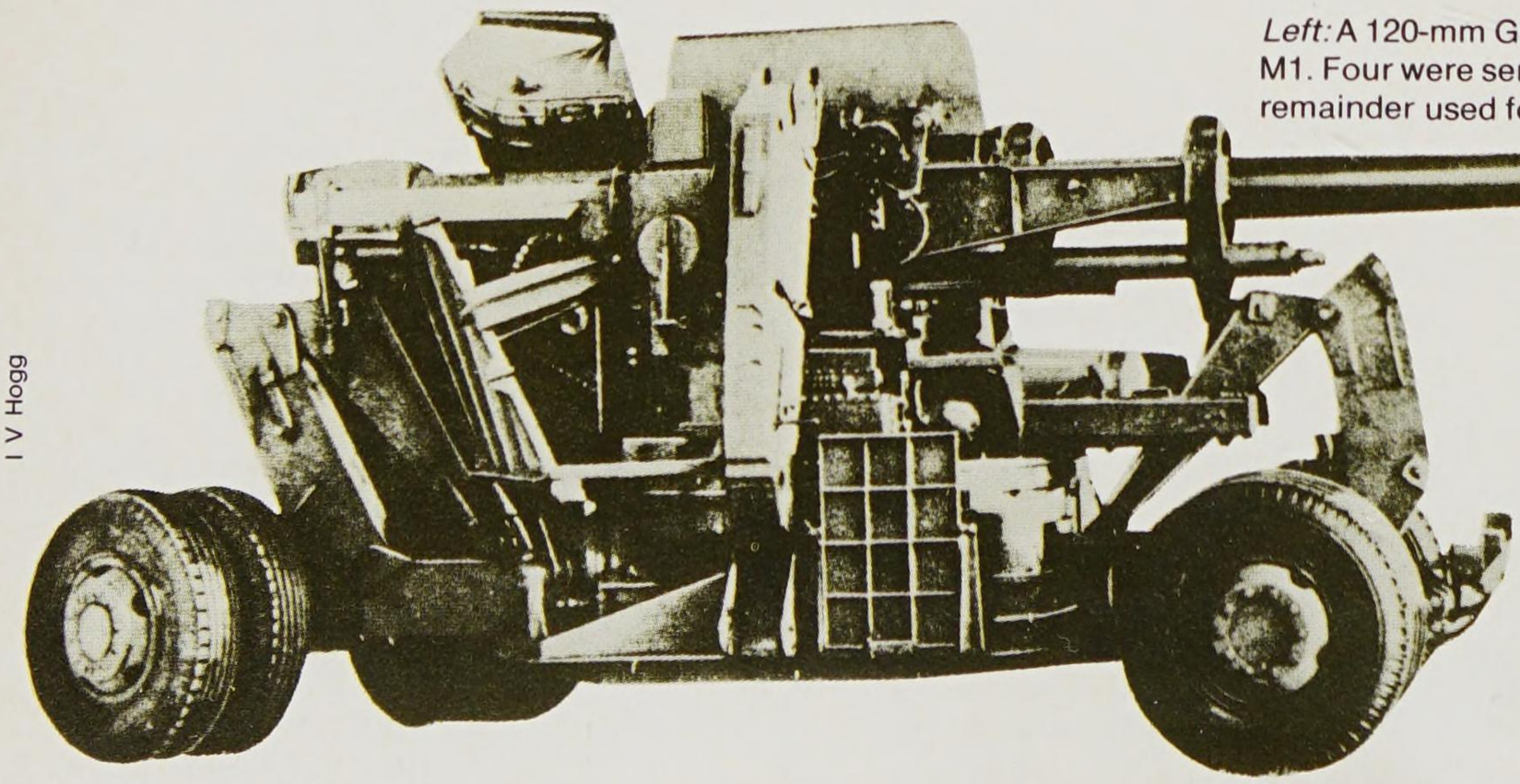
90-mm M1

By the mid-1930s it was becoming apparent that the 3-in guns were no longer in the forefront of technology, and in 1938 the Coast Artillery Board (who were responsible for AA equipment) demanded a new gun which would fire a shell of at least 9.5 kg (21 lb) weight but capable of being hand loaded. Ballistic studies indicated that a 90-mm (3.5-in) gun with a 10.9-kg (24-lb) shell would meet the requirement, development began, and the 90-mm Gun M1 was approved for service in March 1940. The gun was a conventional pattern with vertical sliding breech block, and the Mount M1 was a four-outrigger platform which used a single axle and double wheels. One outrigger was fixed and acted as a towing bar, while the other three folded up for travelling. In May 1941 the Mount M1A1 was standardized; this was much the same basic design but had provision for remote power control of the gun from the director, and was fitted with a spring-actuated power rammer to speed up the rate of fire. The M1A1 went into production in advance of standardization, and by the end of 1942 over 2000 had been built. It became the standard field army AA gun and was seen in every theatre of war.

90-mm M2

While the M1A1 was a satisfactory AA gun, the Chiefs of Staff wanted a multi-purpose weapon which could function as an antitank and antitorpedo boat gun as well, and the M1A1 was unsuitable since it could not depress below 0° elevation. Consequently, in May 1943 the Mount M2 was produced. This was a two-axle platform with outriggers, folding shields and folding loader's platform. The gun cradle incorporated the Fuze Setter and Rammer M20, in which rollers took the shell from the loader's hands, set the fuze, and then rammed the round into the breech. This stepped the rate of fire up to 27 rds/min





Left: A 120-mm Gun M1 on AA Mount M1. Four were sent overseas, the remainder used for home defence

I V Hogg

105-mm M3

Shortly after the First World War, development of a 4.7-in (120-mm) heavy AA gun began, but it looked like being a clumsy weapon and it was suggested that something between that and the 3-in (76-mm) might be more useful. This resulted in the 105-mm (4.1-in) AA Gun M1 in 1927. There was some argument about the best method of construction; after trying different types, the M3 was standardized in 1933, but due to the shortage of funds only 14 guns were ever built and these went to the Panama Canal defences. By the time more money was available, the 90-mm (3.5-in) gun was on the way, and since this gave almost as good a performance and was a mobile gun into the bargain, the 105-mm was abandoned.

I V Hogg

A Gun 40-mm (1.57-in) M1 (Bofors) guarding an airfield during the Second World War

120-mm M1

The 4.7-in (120-mm) gun first appeared in 1924 on a self-propelled mounting designed by Walter Christie but shortage of cash led to the project being shelved for many years. It was revived in 1938 to become a mobile heavy gun on a towed platform. It was introduced as the 4.7-in Gun M1 in late 1940, the nomenclature being changed to 120-mm Gun M1 in January 1944. Only 550 were made, and except for four which were sent in error to Northern Ireland in 1942, they were kept within the continental United States.

40-mm M1

The famous 40-mm (1.57-in) Bofors gun caught the eye of the US Navy in 1937, but attempts to buy some for trial fell through due to misunderstandings with the Bofors company. Upon the outbreak of war, interest revived and the Navy and Army managed to obtain a gun each from Britain. The Army standardized the 40-mm Gun M1 in May 1941 and began negotiation for a licence to manufacture. The M1 carriage was the original Bofors design and was not well suited to American manufacturing methods, so it was redesigned by the Firestone Tire company, with a welded frame, tubular axles and electric brakes, to become the Carriage M2 in December 1941. There were no changes in the gun design other than altering the tolerances to American standards. An air-portable version, the Carriage M5, was later developed and saw considerable use in the Pacific.

75-mm M51

The development of the proximity fuze for AA use meant that the need to set a time fuze no longer existed, and thus the ammunition supply could be streamlined and the rate of fire speeded up. In August 1944 a requirement was stated for 'a short and intermediate range AA gun to be compatible with proximity fuzes' and 75-mm (2.95-in) was selected as the calibre. Four pilot models were ordered: two to be simply fast-firing guns with remote power control, one towed and one on a self-propelled mount, and two to be the same but with the incorporation of an 'on-carriage fire control system' with radar, predictor and optical tracker/rangefinder all on the traversing part of the mounting.

Gun design was complete by January 1945 but the mounting was more involved and took longer, and the first pilot was not ready until the summer; even then, the predictor/radar/tracker installation was not ready. But when it came to firing the gun, it was found capable of only 700 m/sec (2300 ft/sec) muzzle velocity, which was nowhere near good enough in 1945. The designers were sent back to try again, with 915 m/sec (3000 ft/sec) as their target. They never made it; 853 m/sec (2800 ft/sec) was the best they ever managed, and eventually the 75-mm AA Gun M51, or Skysweeper, reached service in the early 1950s. Only the towed equipment appeared; a test model of the SP equipment was built on an M24 tank chassis, but it was far too clumsy and the project was dropped.

Skysweeper used twin revolver magazines at the rear of the mounting which fed across, alternately, to a central ramming unit, and it was capable of firing at 45 rds/min.

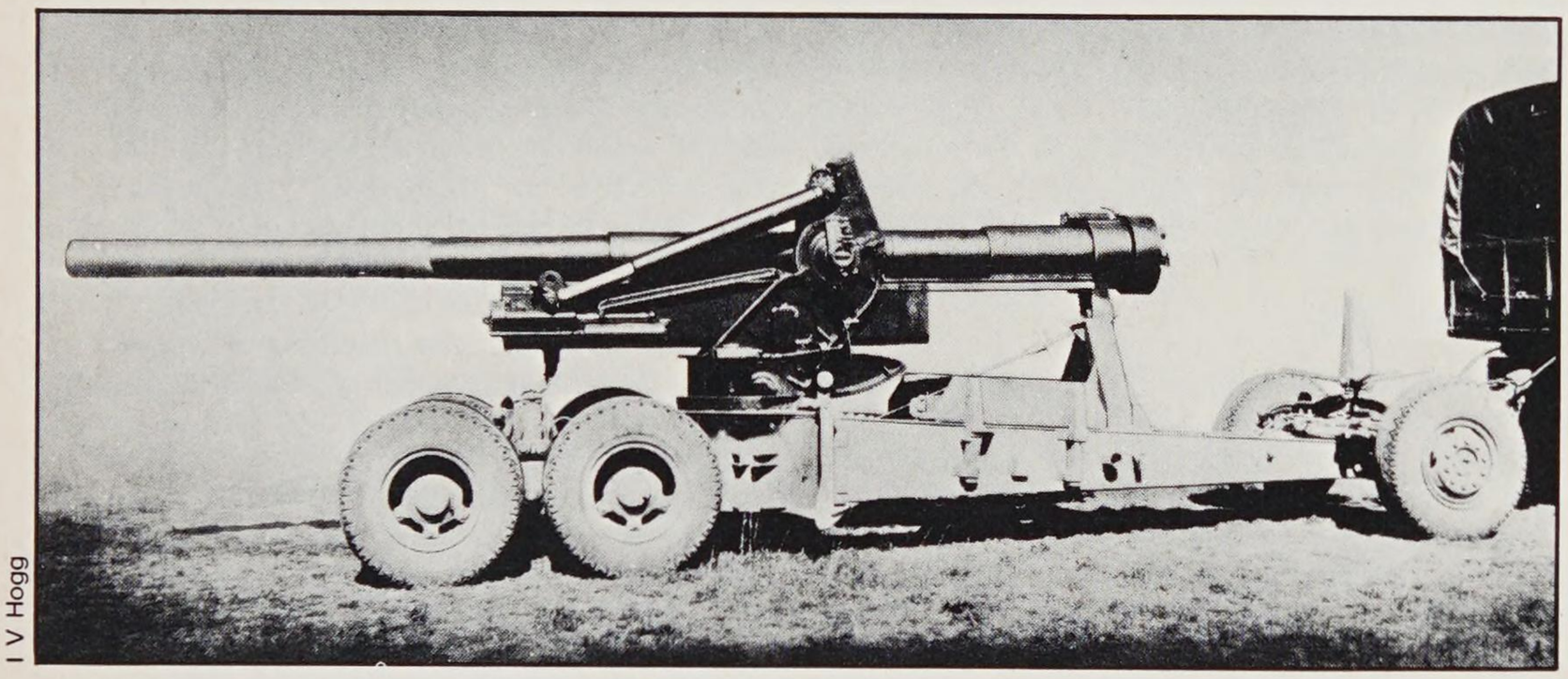
With the advent of guided missiles, guns were gradually phased out of US service. By the late 1970s there were a handful of SP Twin 40-mm (1.57-in) equipments which were scheduled for replacement by light missiles, but numbers of 20-mm (0.79-in) Vulcan guns are used for close defence. These consist of the 20-mm Gatling-type power-driven Vulcan gun on either trailed or SP mountings.

The US 75-mm Skysweeper AA gun was developed near the end of the Second World War but changes in the specifications delayed delivery until the early 1950s. It included in one mount its fire-control equipment, radar and predictor and was described at the time as 'the gun with a mind of its own'. It could fire 35 rounds a minute from two ten-round automatically fed magazines. The gun was originally designed to fire AA and AP ammunition at 915 m/sec (3000 ft/sec), but this was reduced to 850 m/sec to (2800 ft/sec) in the production gun. One revolutionary feature of the gun was the use of proximity fuzes developed at the end of the war

ANTIAIRCRAFT GUN DATA

Gun	Weight in action (kg/lb)	Weight of shell (kg/lb)	Muzzle velocity (m/sec/ft/sec)	Effective ceiling (m/ft)	Rate of fire (rds/min)	Ground range (m/yds)
37-mm M1	2819/6124	0.59/1.3	792/2600	3200/10 500	120	8115/8875
40-mm M1	2517/5549	0.95/2.1	875/2870	3353/11 000	120	9920/10 850
75-mm M51	9355/20 625	6.8/15	853/2800	9754/32 000	45	14 630/16 000
3-in M3 (Mobile)	5534/12 200	5.85/12.9	880/2888	8504/27 900	25	13 515/14 780
3-in M4 (Static)	6800/15 000	5.85/12.9	853/2800	8840/29 000	25	12 985/14 200
90-mm M1	8620/19 000	10.6/23.4	823/2700	10 300/33 800	15	17 830/19 500
90-mm M2	14 650/32 300	10.6/23.4	823/2700	10 300/33 800	27	17 830/19 500
105-mm M3	15 210/33 538	14.88/32.8	853/2800	11 278/37 000	15	18 290/20 000
120-mm M1	22 135/48 800	22.68/50.0	945/3100	14 478/47 400	12	25 235/27 600

Heavy Artillery



I V Hogg

A 155-mm Gun M1A1 on Carriage M1. The M1A1 was developed from the French 155 GPF

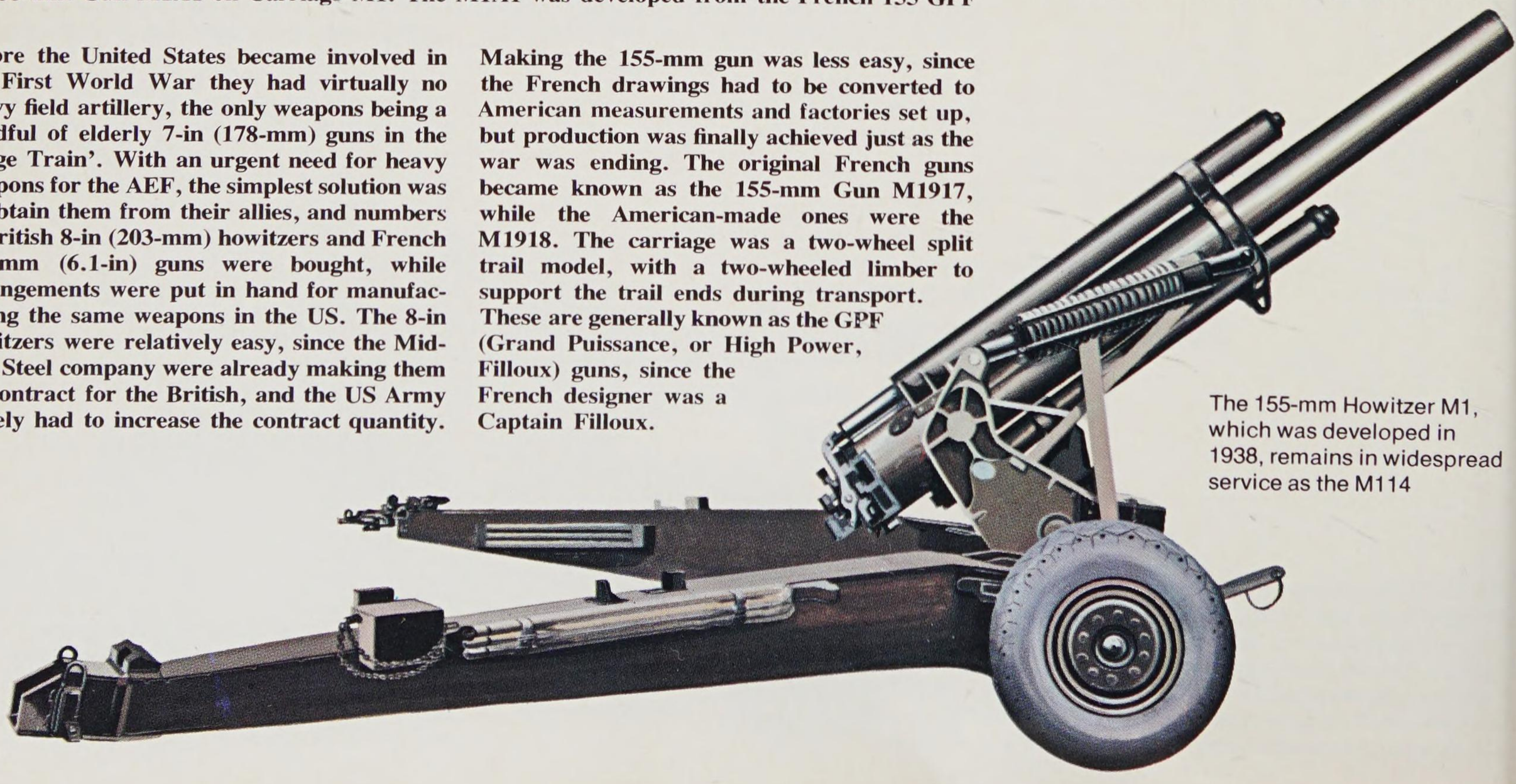
Before the United States became involved in the First World War they had virtually no heavy field artillery, the only weapons being a handful of elderly 7-in (178-mm) guns in the 'Siege Train'. With an urgent need for heavy weapons for the AEF, the simplest solution was to obtain them from their allies, and numbers of British 8-in (203-mm) howitzers and French 155-mm (6.1-in) guns were bought, while arrangements were put in hand for manufacturing the same weapons in the US. The 8-in howitzers were relatively easy, since the Midvale Steel company were already making them on contract for the British, and the US Army merely had to increase the contract quantity.

Making the 155-mm gun was less easy, since the French drawings had to be converted to American measurements and factories set up, but production was finally achieved just as the war was ending. The original French guns became known as the 155-mm Gun M1917, while the American-made ones were the M1918. The carriage was a two-wheel split trail model, with a two-wheeled limber to support the trail ends during transport. These are generally known as the GPF (Grand Puissance, or High Power, Filloux) guns, since the French designer was a Captain Filloux.

During the 1920s these guns were gradually improved by adapting them for high-speed towing, and they were also adapted to coast defence use by placing them on a concrete Panama Mount which allowed them to be slewed round to track moving targets. Large numbers were still in service in 1941 and were used as training guns for much of the war.

155-mm Gun M1

During the 1920s, though, work began on an improved model, to have greater elevation and more power, and after several setbacks a design eventually crystallized and was standardized in 1938 as the 155-mm Gun M1 on Carriage M1. This was a vast improvement: it was longer, had a more modern breech

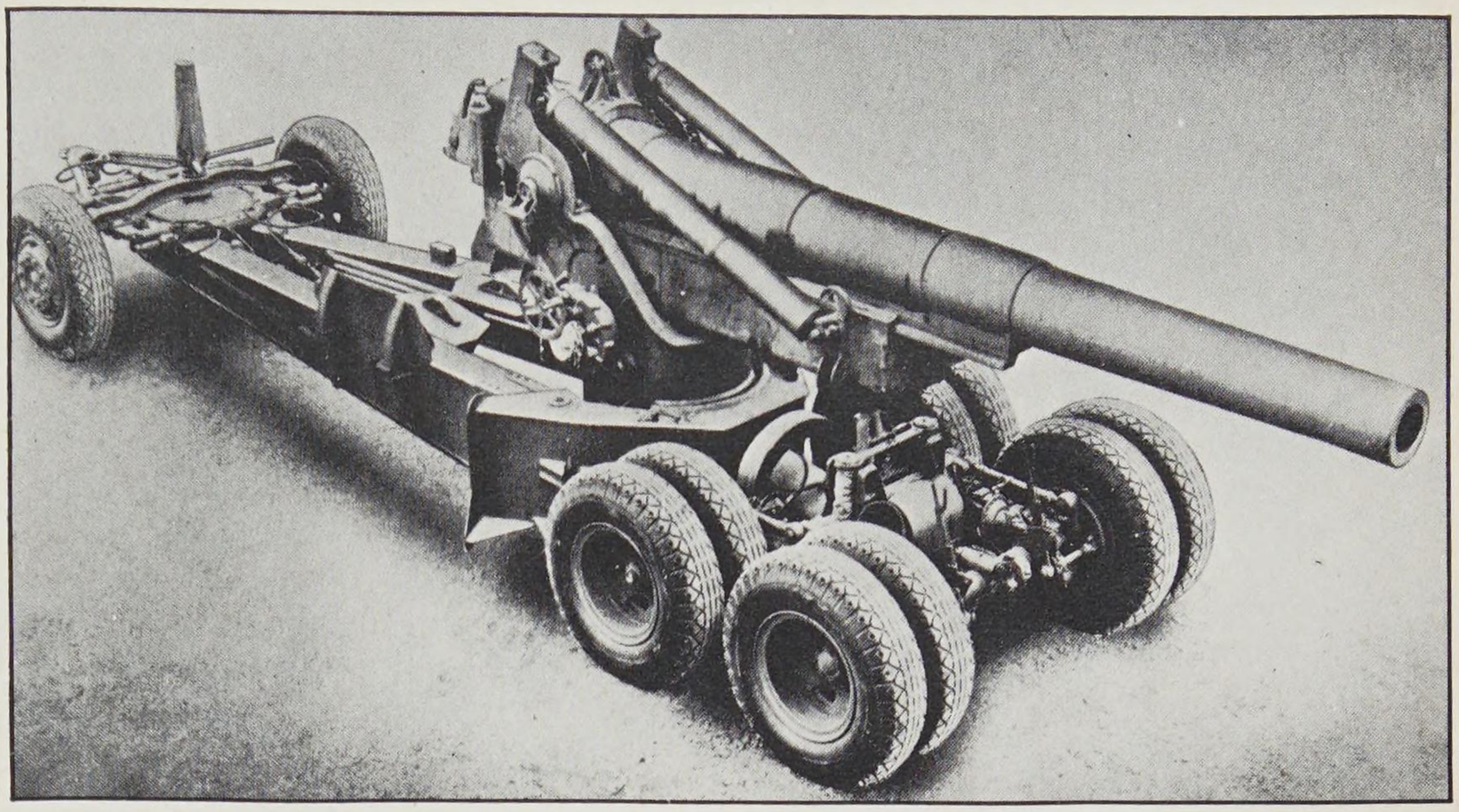


The 155-mm Howitzer M1, which was developed in 1938, remains in widespread service as the M114

mechanism, and the carriage was a split trail model with an eight-wheeled bogie supporting the main weight and a two-wheeled limber to take the trail ends for movement. It became the standard heavy gun of the US Army, was adopted by the British Army, and remained in service with both until the 1950s, while numbers are still in use with other armies throughout the world in the late 1970s.

8-in Howitzer M1

The 8-in (203-mm) howitzer was an elderly design, a cumbersome affair with a box trail and traction-engine wheels, and work on producing a new model started in the 1920s. One primary aim was to produce a weapon which would fit the same carriage as the new 155-mm (6.1-in) gun, to ease production problems, and, again after several designs had been tested and discarded, the 8-in Howitzer M1 was approved in 1940. Except for the barrel, it is almost identical with the 155-mm gun, using the same breech mechanism and carriage, though some adjustments have to be made to the carriage in order to suit the different weight and balance of the 8-in barrel. As with the 155-mm gun, the 8-in was adopted by the British Army during the war and by other countries afterwards, and was still in service in 1978 since it was found to be an ideal weapon for firing a nuclear shell. The latest model is known as the M115, but the differences between it and the M1 are minor.



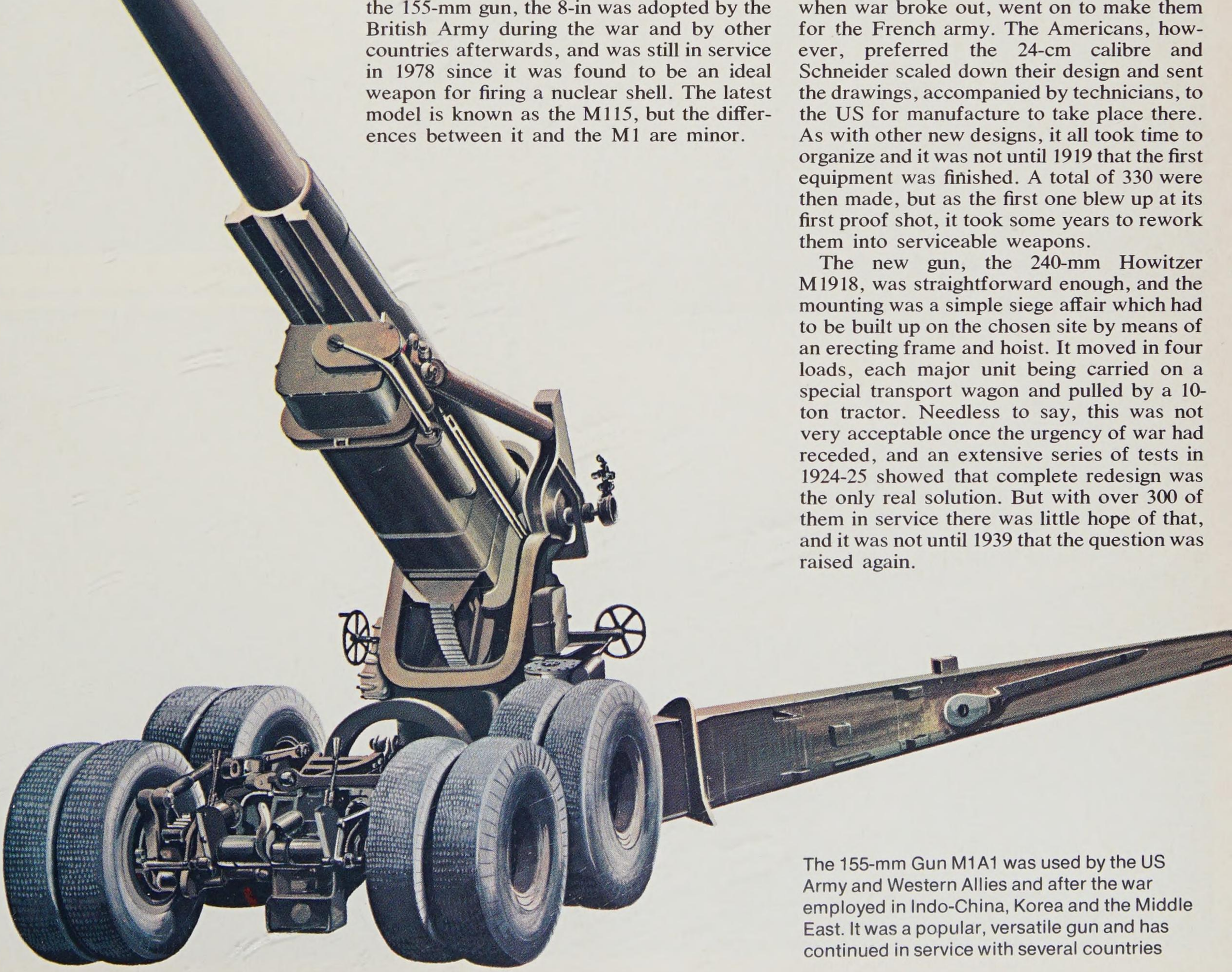
I V Hogg

The 8-in Howitzer M1 on carriage M1, the same carriage as that used with the 155-mm

240-mm Howitzer M1918

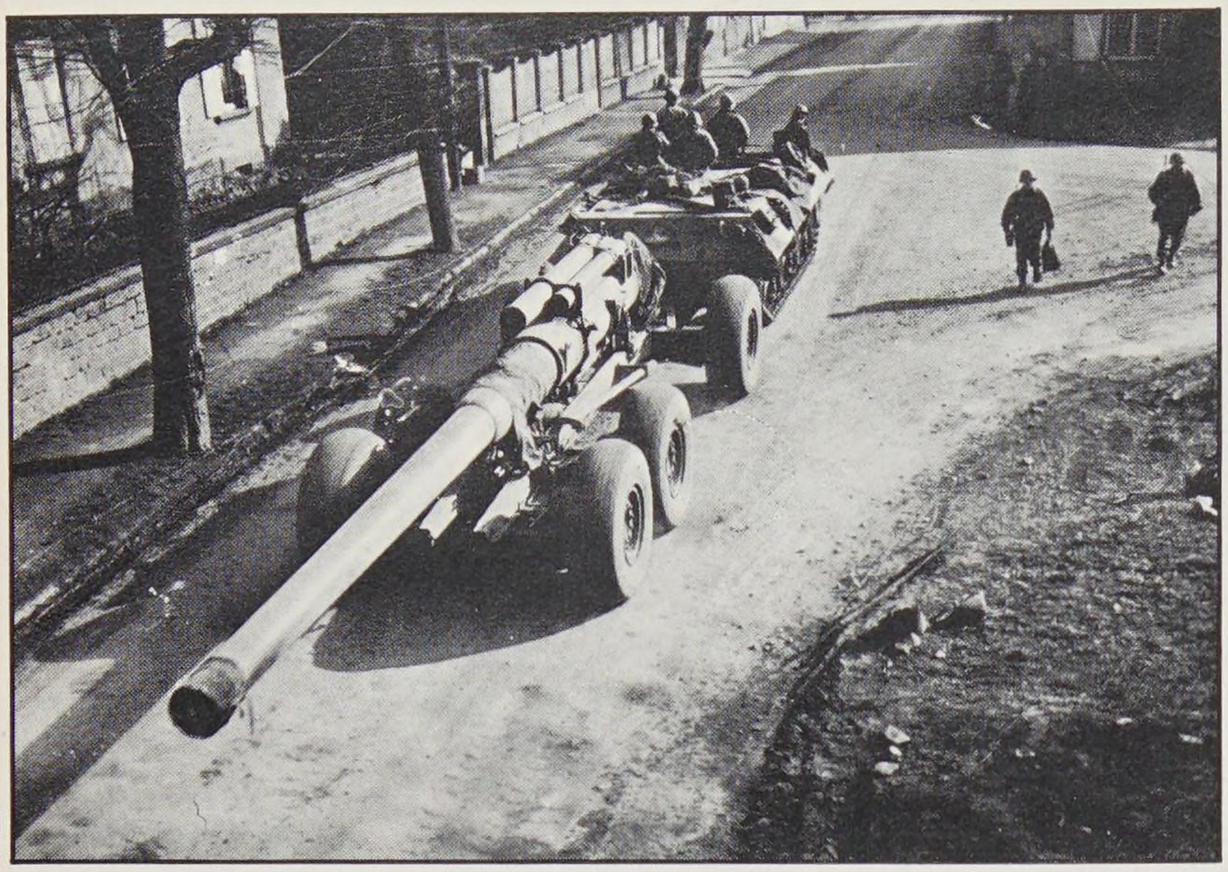
Another weapon which attracted the attention of the US Army during the First World War was a 240-mm (9.45-in) howitzer designed by the Schneider company of France. This company had built a 28-cm (11-in) howitzer for the Russians in 1911 and, when war broke out, went on to make them for the French army. The Americans, however, preferred the 24-cm calibre and Schneider scaled down their design and sent the drawings, accompanied by technicians, to the US for manufacture to take place there. As with other new designs, it all took time to organize and it was not until 1919 that the first equipment was finished. A total of 330 were then made, but as the first one blew up at its first proof shot, it took some years to rework them into serviceable weapons.

The new gun, the 240-mm Howitzer M1918, was straightforward enough, and the mounting was a simple siege affair which had to be built up on the chosen site by means of an erecting frame and hoist. It moved in four loads, each major unit being carried on a special transport wagon and pulled by a 10-ton tractor. Needless to say, this was not very acceptable once the urgency of war had receded, and an extensive series of tests in 1924-25 showed that complete redesign was the only real solution. But with over 300 of them in service there was little hope of that, and it was not until 1939 that the question was raised again.

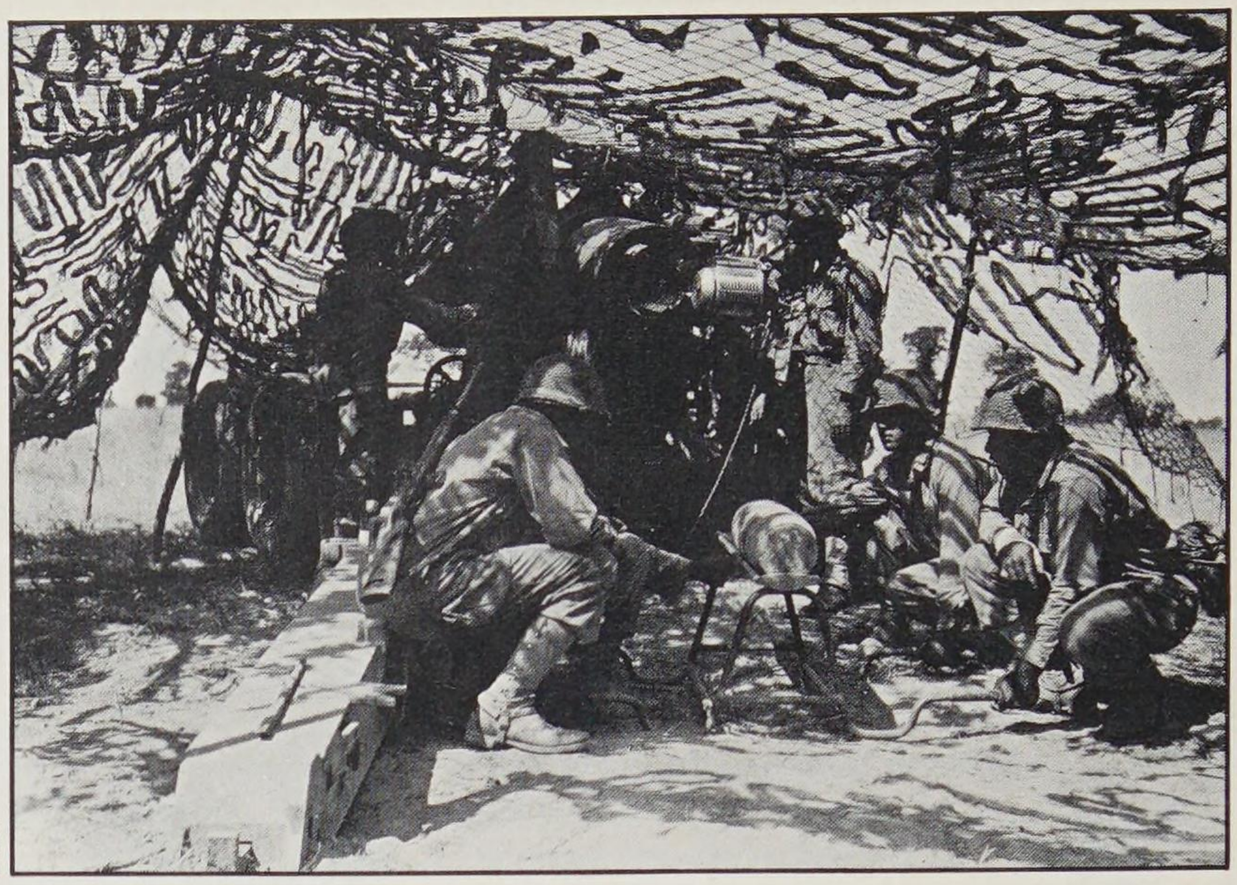


The 155-mm Gun M1A1 was used by the US Army and Western Allies and after the war employed in Indo-China, Korea and the Middle East. It was a popular, versatile gun and has continued in service with several countries

Heavy Artillery



IWM

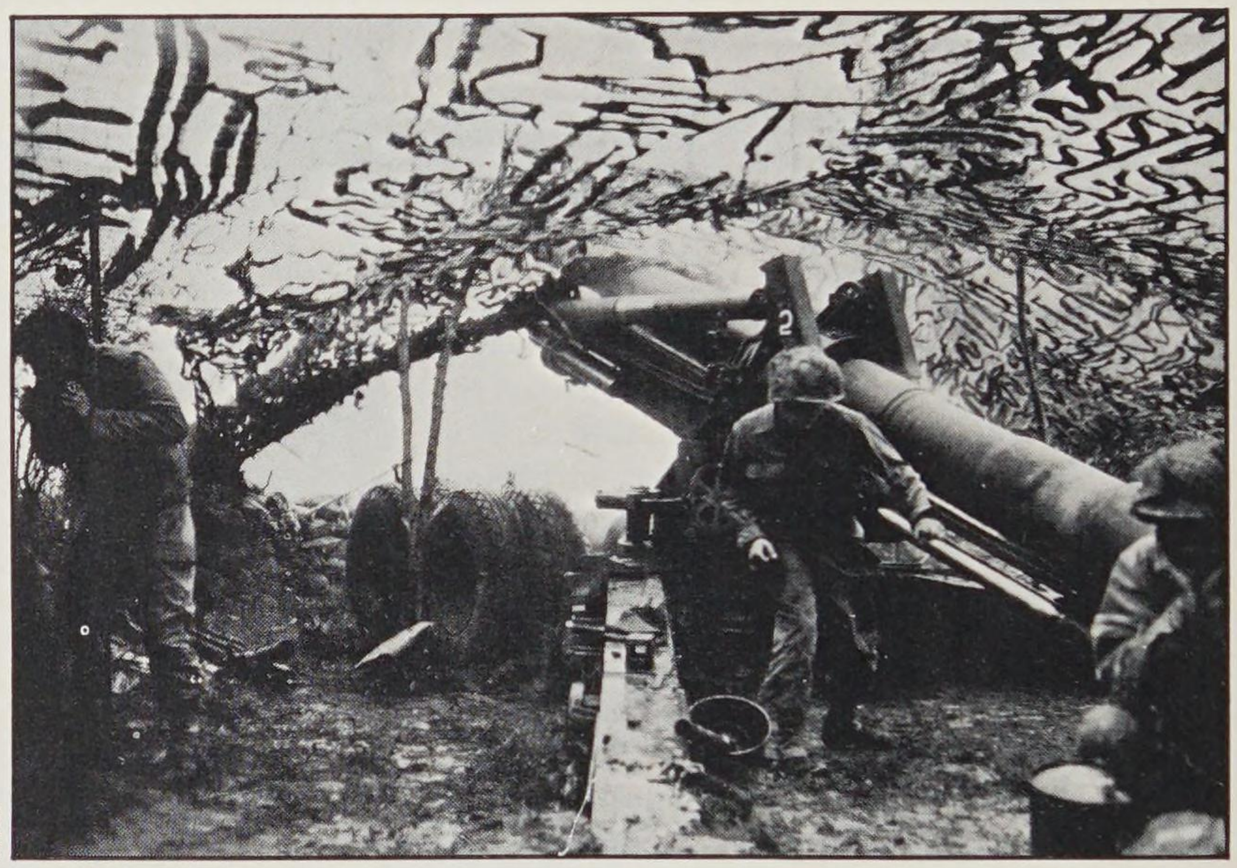


IWM

Above: A tank destroyer tows an 8-in (203-mm) gun through a French town in 1945. *Below:* An 8-in gun in action against German-held Brest

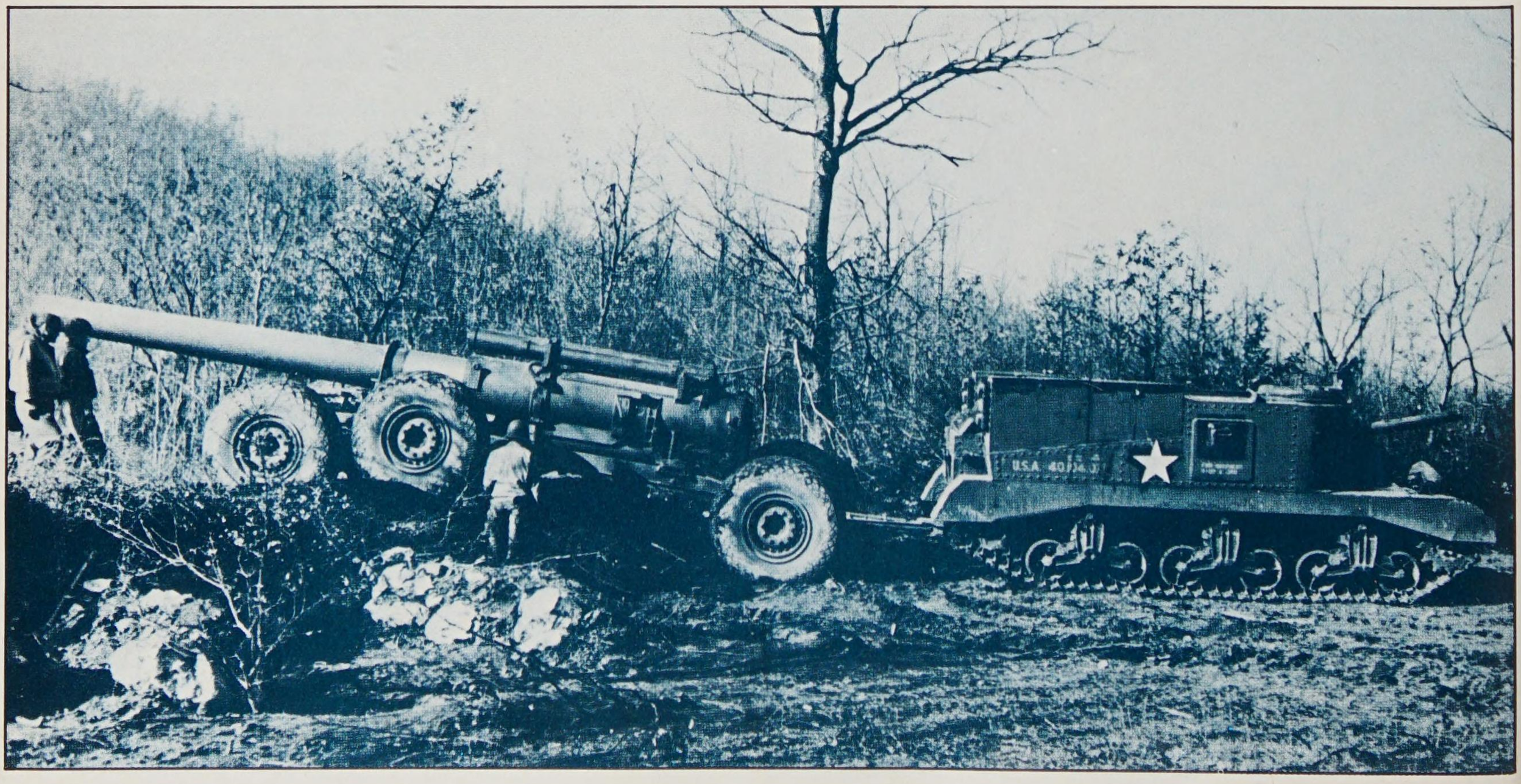
Above: The crew of an 8-in Howitzer await the order to load. *Below:* An 8-in Howitzer fires a Fourth of July barrage against the Germans

IWM



IWM

A turretless M3 Grant tows the barrel unit of a 240-mm (9.45-in) Howitzer M1. The carriage was transported on two six-wheeled transport wagons



IWM

240-mm Howitzer M1

In April 1940 work began on a completely new weapon in two units, barrel and carriage. The barrel was carried on a semi-trailer, and the split-trail carriage had its front end 'kicked-up' to hook on to a tractor so that with the trail ends riding on a four-wheeled trolley it too could be semi-trailed.

This was a very ingenious design but proved to have poor cross-country mobility, so the idea was changed to two six-wheel transport wagons on to which the barrel and carriage could be either lifted by crane or eased on by winches in the towing tractors. This went into production in 1943, being standardized as the 240-mm Howitzer M1. It was later adopted by the British Army and saw considerable use in Italy. It remained in service with both armies until the 1950s.

8-in Gun M1

Another idea which appeared in the 1920s was that of building an 8-in (203-mm) long-range gun which would be movable by road. Some studies were done but the idea was shelved in 1924 until 1939 when the idea of making a 'partner piece' for the 240-mm (9.45-in) howitzer was born. Work began in 1940 to develop a gun which would fit the same carriage as the 240-mm Howitzer M1 but a great deal of trouble arose in development and it was not until January 1944 that the 8-in Gun M1 was standardized.

The trouble was excessive bore wear and poor accuracy, and various solutions were tried: various systems of rifling were tested, the bore was chromium-plated, the propelling charges changed, but it was still not perfect and was only accepted for service because there seemed little prospect of finding a better design. Relatively few were used, and they were not kept in service for very long after the war.

Gun, Heavy, Motorized, M65

In October 1944 a project for a 240-mm (9.45-in) gun and 280-mm (11-in) howitzer 'partner pair' was begun. It was suggested that the split-trail carriage would have tracked suspension and for short moves the barrels could be pulled back on the trail. For longer moves the first idea was to remove the barrel and then tow the carriage on its tracks, but later it was suggested that it might be a good idea to hoist the whole thing up, run tractors under each end, and simply drive off with it.

When the war ended, this proposal seemed less and less important, and eventually the pair of weapons was boiled down to produce one, a 280-mm gun. One of the reasons behind this weapon appearing at all was that at about the same time, the scientists had managed to manufacture a nuclear device capable of fitting inside a 280-mm artillery shell, and therefore the 280-mm gun finally appeared as Atomic Annie or Gun, Heavy, Motorized M65 and startled the military world by firing the first artillery nuclear shell in May 1953. It then went into limited production and became the US Army's tactical nuclear delivery system in Germany.

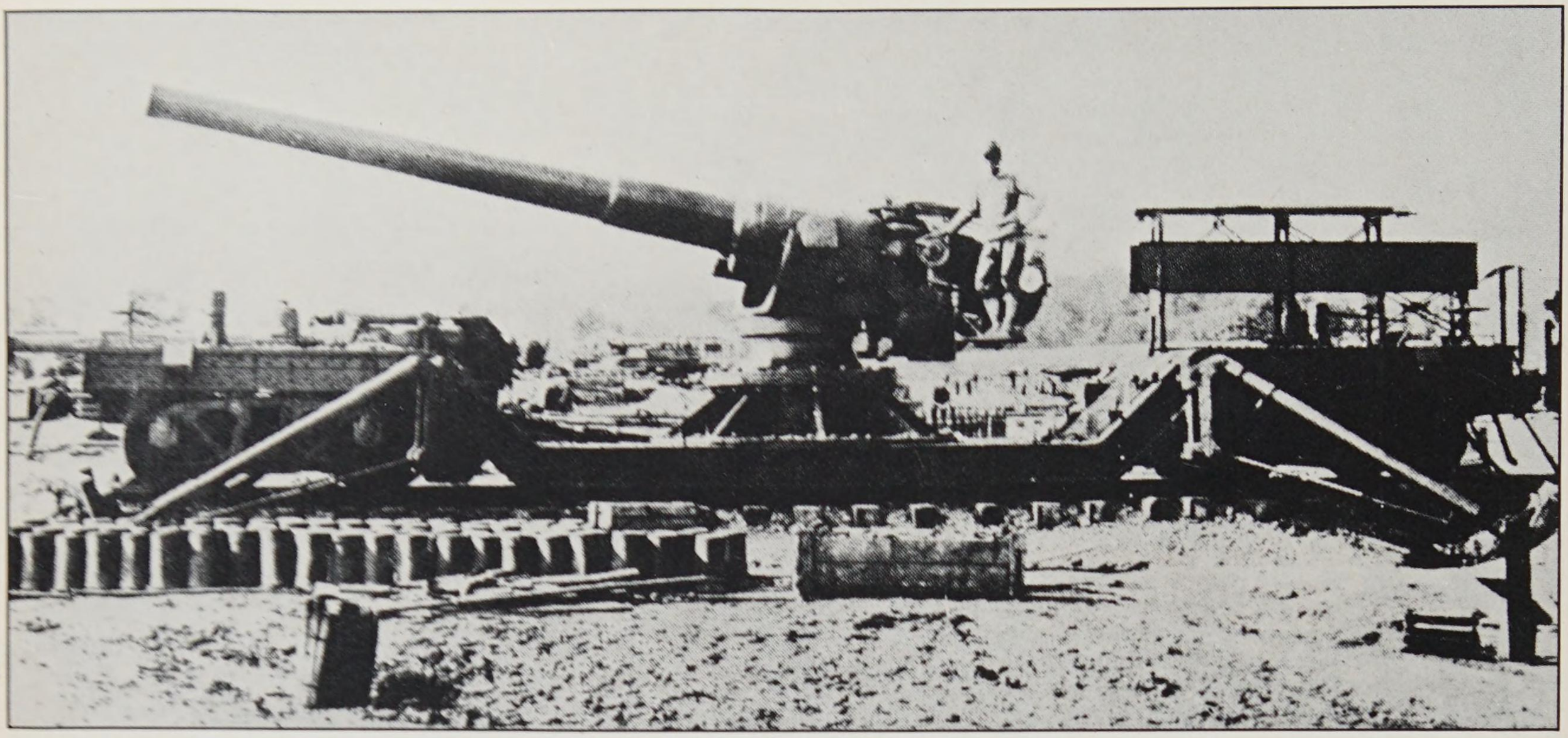
Unfortunately, when it came to practical exercises, it was found to be much too cumbersome; it weighed 75 000 kg (74 tons) on the move and was over 30 m (100 ft) long, and although amazingly manoeuvrable, it was practically impossible to conceal. Since such a weapon would obviously be an enemy's prime target, and, moreover, by the end of the 1950s the Honest John rocket could deliver a bigger warhead to a greater range, the 280-mm gun was taken out of service in the early 1960s. It was the last of the American towed heavy guns.

The US 280-mm M65 'Atomic Annie', which fired the first nuclear artillery shell in May 1953

HEAVY ARTILLERY DATA

Gun	Weight in action (kg/lb)	Weight of shell (kg/lb)	Muzzle velocity (m/sec/ft/sec)	Maximum range (km/miles)
155-mm Gun M1917	11 750/25 905	43.09/95	735/2410	18.4/11.4
155-mm Gun M1	13 880/30 600	43.09/95	853/2800	23.2/14.4
8-in Howitzer M1	14 380/31 700	90.72/200	594/1950	17/10.5
8-in Gun M1	31 435/69 300	108.86/240	866/2840	32.5/20.2
240-mm Howitzer M1918	18 735/41 300	156.49/345	518/1700	15/9.3
240-mm Howitzer M1	29 345/64 700	163.3/360	701/2300	23/14.3
280-mm Gun M65	42 635/94 000	272/600	762/2500	28.7/17.8

Rail Guns



I V Hogg

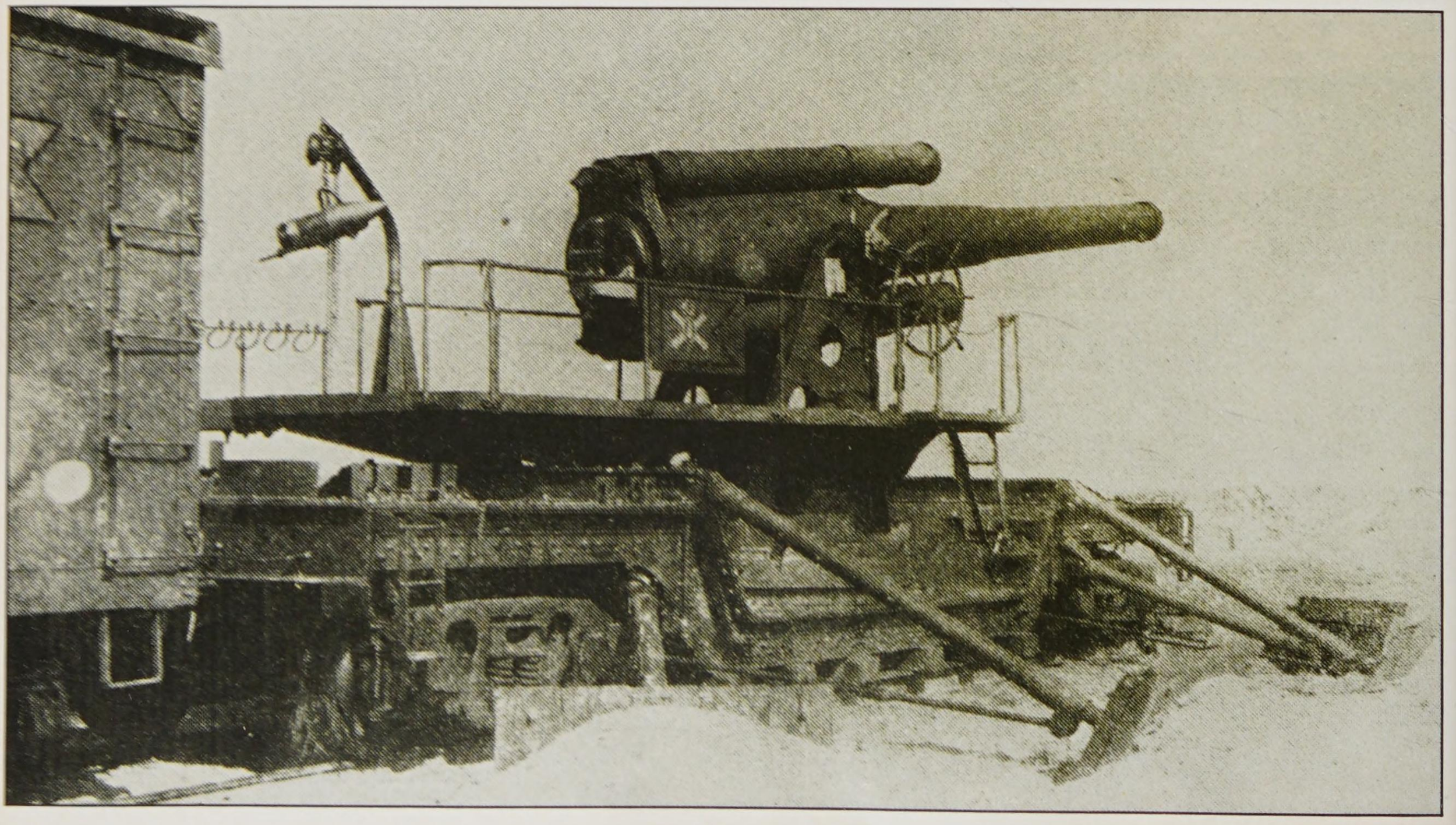
A US Rail Gun 7-in (178-mm) Naval Mk II, the first US rail gun to be developed since the Civil War. Twelve of these rather crude carriages were built on strengthened flat cars and deployed along the American coast during the First World War. They were scrapped in the 1920s

Although the Americans were among the first to use railway artillery when they mounted 13-in (330-mm) mortars on flatcars during the Civil War, it was not until 1917 that anything further was done along these lines. The first railway artillery to be developed during the First World War was for emergency coast defence and consisted of 12 ex-Navy 7-in (178-mm) guns and 18 4.7-in (120-mm) howitzers mounted on strengthened flatcars and used to bolster the east coast defences. After the war some of the 4.7-in went to Panama, but by the mid-1920s all these had been scrapped.

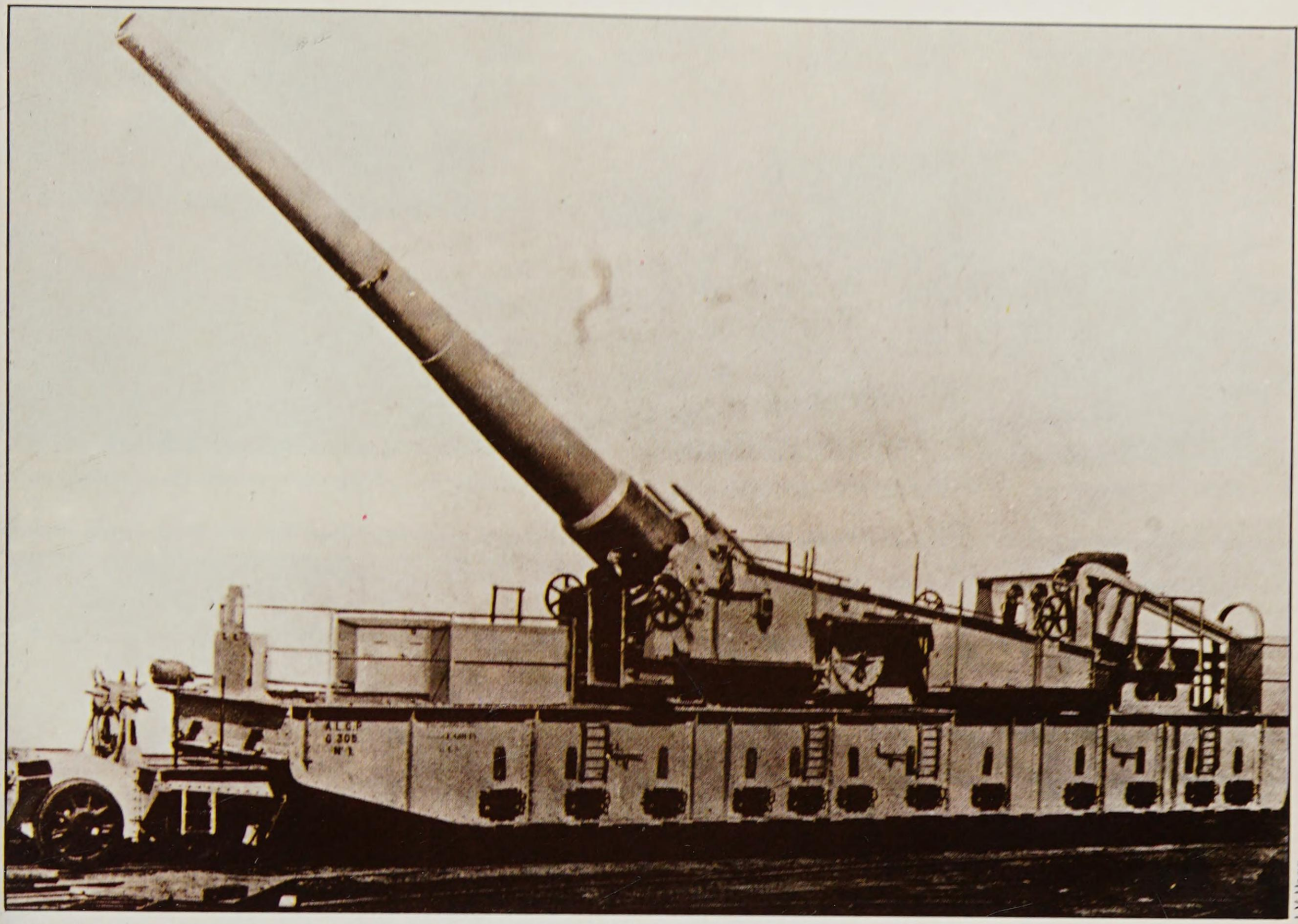
When railway artillery was needed for use in France, the Americans took a leaf from the British book and promptly raided their store of coast artillery weapons. Numbers of 8-in (203-mm), 10-in (254-mm) and 12-in (305-mm) guns and 12-in mortars were thus acquired, and the next problem was to produce some mountings for them. The 8-in guns and 12-in mortars were relatively light, and a strengthened two-bogie well-type flatcar with a pedestal in the centre gave all the support necessary for these weapons. It also allowed them 360° of traverse, provided the car was suitably braced to prevent it toppling over when fired across the tracks.

The heavier guns were more of a problem. The French army had developed two types of

A Rail Gun 8-in (203-mm) M1888 on Rail Car M1918, a two-bogie flat car with side braces to permit 360° traverse and firing across the tracks



I V Hogg



A US 12-in (305-mm) M1895 on a Batignolles mount. Originally a French mount, adopted by the Americans and used exclusively with the 12-in

mounting which the Americans now adopted. One was the Sliding mount, the other the Batignolles mount.

The Sliding mount was astonishingly simple. It consisted simply of two massive side-plates joined together by transoms and with trunnion seats in the top surface. The gun was slung directly into these seats, with no recoil mechanism at all. The whole unit was carried on wheels for movement, but once in position the wheels were taken away and the mounting rested on the railway track.

When the gun fired, the recoil force passed straight into the side plates and the whole equipment slid back along the track until friction stopped further movement. After a few shots the wheels were jacked into place and the whole affair was pushed back to the starting point, whereupon the wheels were removed once more and shooting began again. Obviously there was no traverse of the gun on the mounting, so it had to be pointed at the target by pushing along a curved track until it was nearly aligned, and after the wheels were off the whole mounting was slid across the track by winches to lay the gun. Primitive wasn't the word, but at least it was cheap and easy to make quickly.

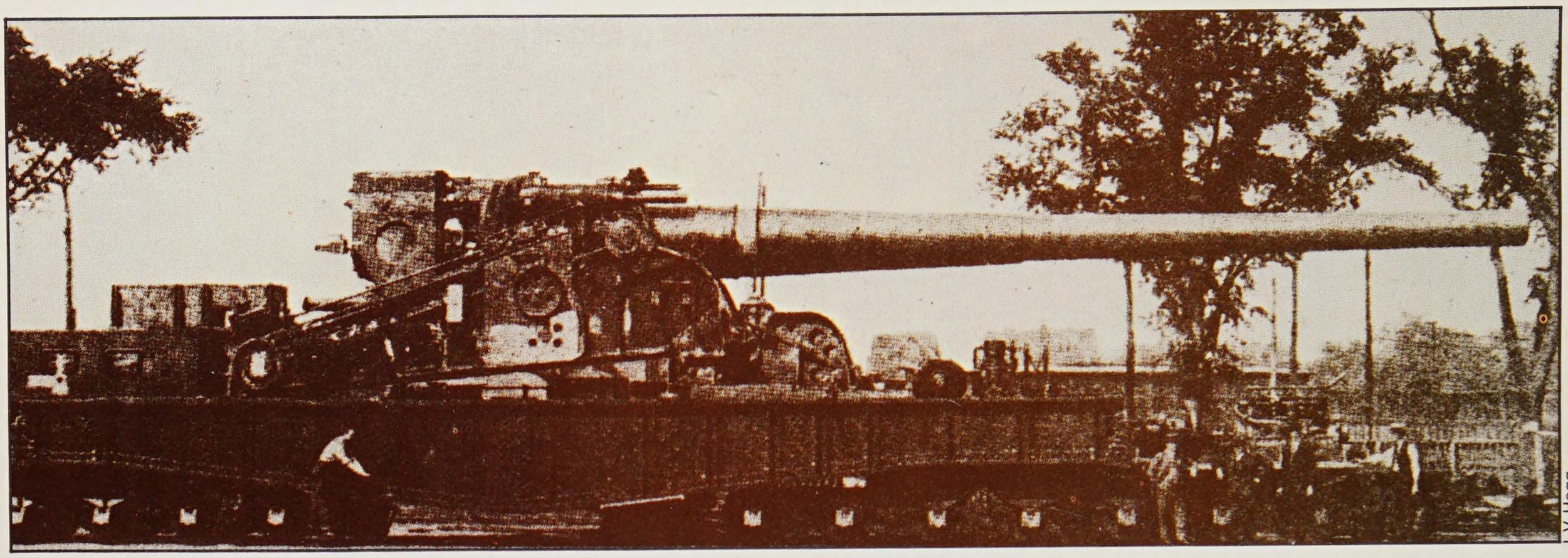
The Batignolles mount was much more sophisticated. It was a steel box, mounting the gun, and slung on two bogies for transport. The gun was in a ring cradle with a recoil system. To put the gun into action the location was first selected and the track removed to make way for a prefabricated ground platform of steel beams. The track was relaid across the top of this and the gun shunted into place. Wedges were driven between the side beams of the platform and the sides of the mounting, and the mounting was then clamped securely to the track. The gun had 10° of traverse in the mounting, but coarse pointing, as before, had to be done by positioning the mounting along a curved track; two of the prefabricated platforms were carried so that they could both be laid out on the curve and the gun shifted from one to the other to give greater coverage of the front. Only the 12-in (305-mm) gun was used with the Batignolles mount; both 10-in (254-mm) and 12-in went on the Sliding mounts.

For reasons, doubtless, of prestige, the US Navy decided to produce some 14-in (356-mm) railway guns and send them to France manned by Marines, and five guns were designed by the Naval Bureau of Ordnance. These were sent to France under command of Rear-Admiral C P Plunkett, and went into action on September 6, 1918. All five guns were engaged by the end of the war and fired a total of 728 shells.

At the end of the war many of the Sliding mount equipments were scrapped, but the 8-in (203-mm) guns, 12-in Batignolles and 12-in mortars were retained, and work began on an army design of 14-in (356-mm) gun. The navy had handed some of their 14-in over to the army (one, in fact, remains in the Dahlgren navy yard to this day), but by this time the army had come up with a new idea. One of their constant problems was the imbalance between their thousands of miles of coastline and their handful of coast artillery guns, and the prospect of using rail guns to act as a mobile reserve was being actively promoted; not merely 7-in (178-mm) guns on flatcars, but very heavy weapons.

The answer came from examination of German techniques. The Germans had made concrete plinths on the Belgian coast, and then had run railway guns across them and removed the wheels, leaving the gun mounting to be swivelled around the plinth. It was therefore decided to prepare concrete bases all round the US coast, close to existing railway tracks, so that a gun could be run out there when needed, dropped onto the base, and an instant coast gun would be ready for use. The first attempt was made by taking the 12-in (305-mm) Batignolles gun and making a swivelling mount from the underpinnings of a 10-in (254-mm) coast mounting. This was workable but not very convenient, and the idea was dropped.

Eventually a 14-in (356-mm) gun on a completely new mounting was devised. This was the normal two-bogie railway mount, but carried a small turntable beneath its centre. A



I V Hogg

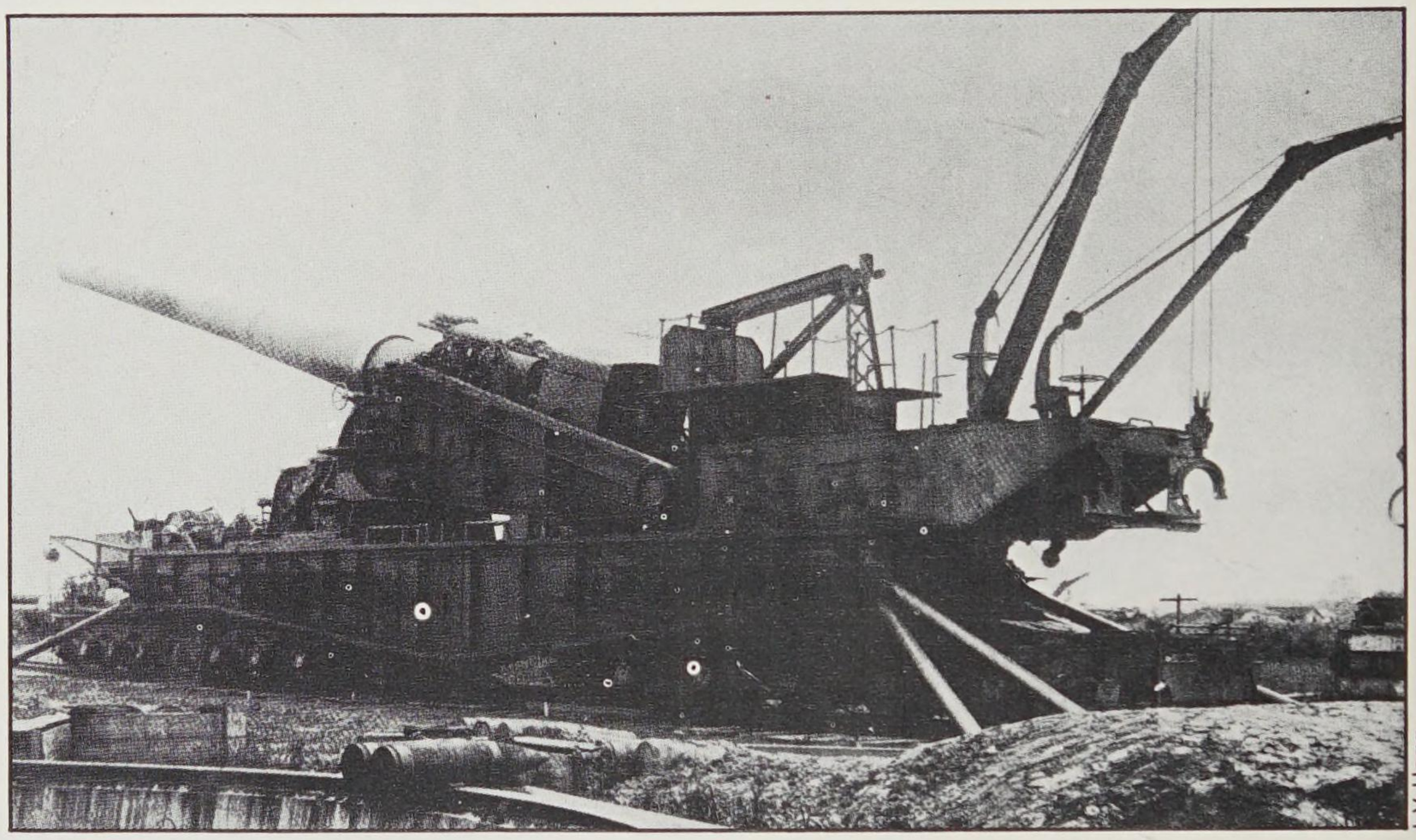
A 14-in (356-mm) Gun (Army) M1920. The gun and top carriage have been raised into firing position during a demonstration in an artillery park

prepared pivot could be installed on a concrete base and the gun's platform bolted to it. The wheels were then removed and the gun could be easily swung through a complete circle. Four 14-in Guns M1920 were built; two were eventually stationed at San Pedro, California, while the other two went to Panama to form part of the armament of Fort Grant at the Pacific end of the Canal.

One last equipment devised during the First World War should be mentioned. This was a 16-in (406-mm) coast howitzer. This had been developed as a fixed emplacement weapon, but in 1920 one was put on to a railway mounting. It worked, but money was scarce and there seemed to be little application for such a weapon, so the idea was abandoned.

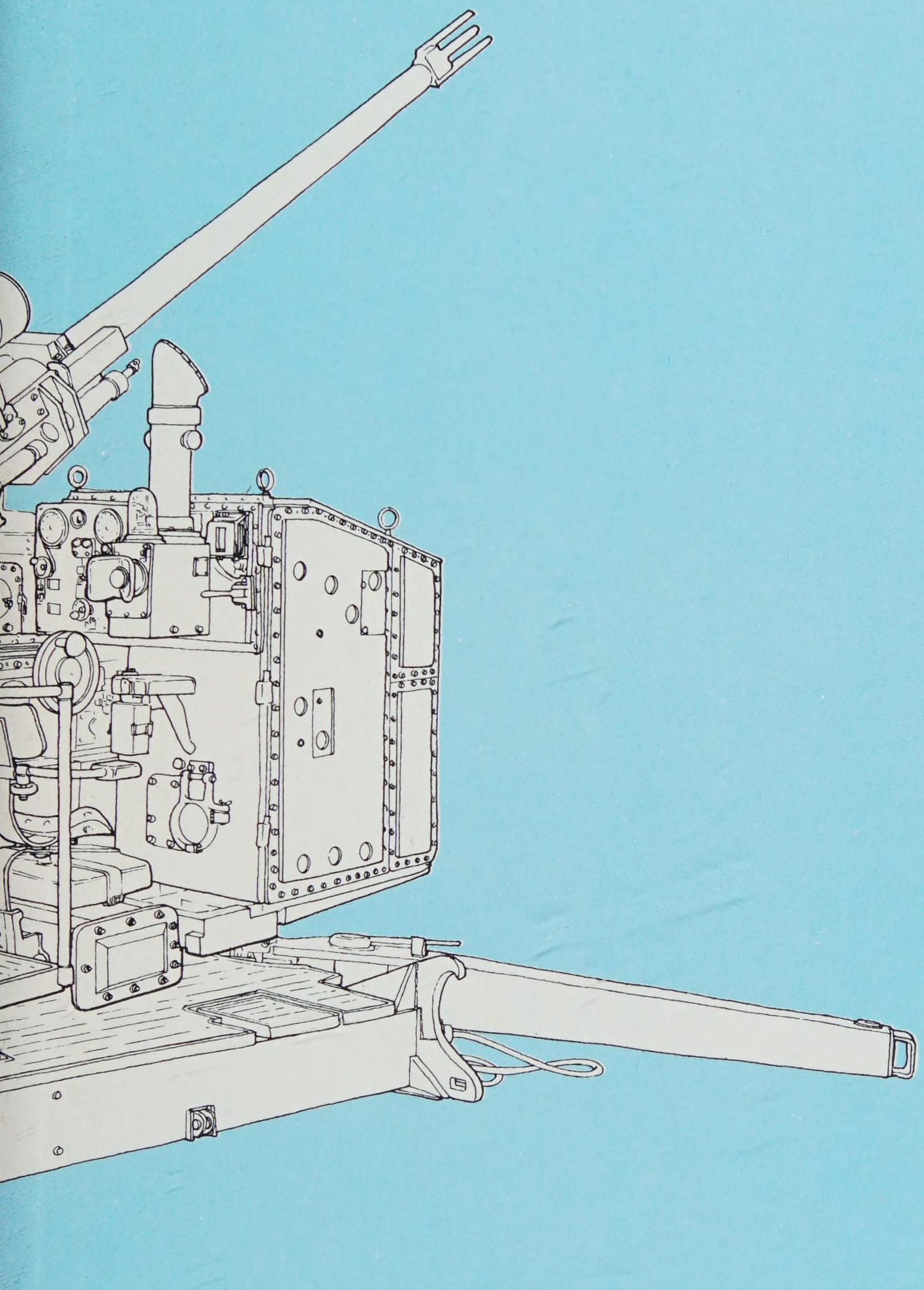
During the Second World War the four 14-in guns remained in their positions; numbers of 8-in guns and 12-in howitzers were brought out of store and spaced around the shores of the United States. But they were never put to use, and by 1944 the last of them had been withdrawn and scrapped.

Below: **A 14-in Gun M1920 on the ranges, ammunition hoists deployed and two shells waiting**



I V Hogg

RAILWAY ARTILLERY DATA

Gun	Weight in action (kg/lb)	Weight of shell (kg/lb)	Muzzle velocity (m/sec/ft/sec)	Maximum range (m/yards)
4.7-in Howitzer M1912	not known	27.22/60	275/900	6080/6650
7-in Naval Gun mk II	not known	74.84/165	823/2700	15 545/17 000
8-in M1888	71 530/157 700	117.93/260	792/2600	21 854/23 900
8-in Mk VI Mod 1	104 325/230 000	117.93/260	838/2750	29 992/32 800
10-in M1888 (Sliding mount)	175 630/387 200	231.33/510	686/2250	21 945/24 000
12-in Gun M1895 (Batignolles)	146 055/322 000	442.25/975	6034/2275	27 432/30 000
12-in Howitzer M1890	80 195/176 800	317.5/700	457/1500	13 990/15 300
14-in Gun M1919 (Navy)	260 815/575 000	635/1400	716/2350	38 862/42 500
14-in Gun M1920 (Army)	286 580/631 000*	544.3/1200	914/3000	44 092/48 220
16-in Howitzer M1918	not known	753/1660	594/1950	22 860/25 000

* On emplacement; weight 331 120 kg (730 000 lb) on wheels